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Alphabetical Index to Advertisers, Page 11.

Classified Index to Advertisements, Page 9.

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CONTENTS

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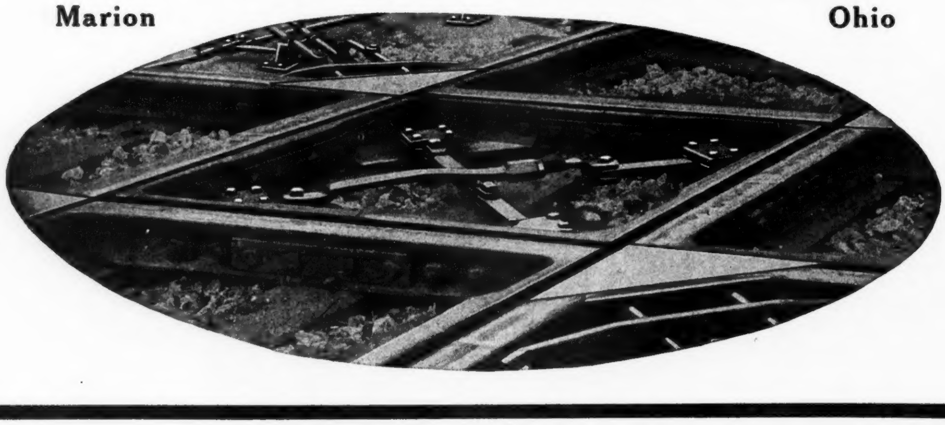

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New Year Greeting

To our readers and patrons whoever and wherever they may be we wish a Happy New Year. May the coming twelve months be full of happiness and prosperity to them; may the past year which has been unfortunately fraught with many perplexities and annoyances be forever forgotten, and may the joys of the future be limited only by the sky above and as far as the North, East, West and South extend. Let us all hope that the prosperity in sight will continue for many decades, and that the dawn of a new era will not be broken in its expansion by interrupting shadows.

Track Labor in Winter

There is an increasing sentiment in the engineering departments of our railroads in favor of maintaining section forces as nearly as possible at the same working strength the year round. The arguments involved have been stated and re-stated until it is only necessary to touch briefly the important points in presenting the case for such a policy.

Track labor has entered the classification of skilled labor. No experienced roadmaster will defend the theory that an untrained man in a section force is worth as much as a man of several seasons' experience. When a man's experience at any kind of work becomes a determining factor in his value for that kind of work he enters the class of skilled labor. The tamping of ballast evenly, to give a smooth-riding track surface; the tightening of joint bolts—tight enough to hold the joint, yet with enough elasticity to allow for expansion and contraction of the rails; the adzing of a rail seat or tie-plate seat to give a bearing on which the rail will maintain line, gauge and surface; the proper sloping of drains to minimize pocketing and stoppage; the fastest possible results in switch and crossing installation or renewals to prevent delays to traffic; all of these parts of the section laborer's work offer opportunities for the experienced man, the skilled laborer, to save time and money for his railroad.

A skilled laborer must maintain his skill by practice. The man who, by not getting steady employment at his regular work is forced to seek other employment, loses his value to himself, and he loses his value to his employers. A skilled track laborer is of no greater value to a farmer for his experience at track work, and the reverse holds true. The versatility of the jack-of-all-trades has lost its commercial value both to the man and to his employer in this age of specialization. An experienced track laborer at $2 a day is a better investment for a railroad than an inexperienced laborer at $1.50. The data compiled by a number of careful roadmasters proves this beyond question. In addition to this disadvantage of employing unskilled track labor, there is the fact that at the usual time of increasing section forces in the spring, the market is the keenest for unskilled labor; farm work, building construction, road construction, municipal improvements, all enter the labor market on a competitive basis, and the unskilled laborer reaps the benefit of this competition by a higher wage than his lack of experience warrants.

The railroad fiscal year, with its inevitable attempts to curtail expenses during the spring months, in anticipation of the annual report has been held largely to blame for the present undesirable condition.

Another factor of perhaps equal moment is the idea that there is not much for track men to do in the winter months, making the saving effected by reducing forces in winter compensate for the higher expense involved in summer work with inexperienced labor. This need not be so. Track men who have given the matter much thought have devised plans for employing section forces in winter in such ways as to reduce the amount of summer work to a point where the winter force will suffice. Distribution of material; care of track and drains during freezing and thawing weather; repairing of tools; cleaning and thawing of switches and interlocking plants; repair work on buildings are all legitimate winter activities by which some roadmasters are utilizing forces of four men throughout the year, rather than two men in winter and six for spring, summer and fall.

To these winter activities can be added increased track inspection, for the broken rail is almost wholly a winter problem, and the care of snow around station buildings, where the patrons of the road can be very satisfactorily impressed by dry, clear platforms and approaches. Wet feet in boarding a train, resulting from wet or slushy platforms are not only a source of annoyance, but often of ill-health to the passengers.

Another solution of the problem of equalizing summer and winter work for track forces is suggested, which provides that section men recruited from the outlying sections be used for the winter work around terminals and classification yards.

Year round employment for track men is the goal. When this can be accomplished, men can be held year

after year, giving the road the results of their experience in the form of skilled labor, and obviating the necessity of competing in the labor markets for unskilled labor at the time when wages are the highest.

Resuscitation After Electric Shock

The increasing use of the electric current on railways for the movement of locomotives, motor cars, shop machinery, signals, etc., as well as for lighting shops, cars, lamps, and for the production of heat, has introduced a new form of danger to menace the unwary. This is the possibility of receiving an electric shock. These shocks may be either permanent or temporary in their effects. If the former, death takes place, usually instantaneously, as as far as we can judge, without any pain. The temporary effects of electric shock produce complete unconsciousness, which, if the victim be not restored, will result in death.

The immediate significance of this fact lies in its bearing on every day conditions. Many of our large railways are electrified on various sections. As this application of electricity is comparatively new, there is necessarily a good deal of misconception, or perhaps ignorance on the part of section men and others who work on the right-of-way as to the nature and power of the current that flows in third rail or overhead wire. It constitutes a menace to safety, and where want of knowledge exists loss of life may result. If one of these men should be struck down or overcome by contact with the electric conductor he appears at once to be beyond the reach of help, although this is not necessarily the case by any means.

The temporary effect has all the appearance of death, and the beholder has no alternative but at once to resort to restorative measures. Medical aid should be summoned without any delay and the witness of the accident should at once begin to produce artificial respiration, and persist in it for hours if necessary in order that life may be saved. The rule of action may be very simply stated. It is, that the sufferer from electric shock should at once be treated as one partially drowned. In any case, the victim can do nothing for himself, he appears to be dead and will certainly die, if not effectively cared for, without loss of time.

At first sight the reason for the same restorative measures being applicable alike to cases of apparent drowning and electric shock does not appear. A man apparently drowned has his lungs filled with water. This liquid is too heavy to be expelled in the respiratory process, the principle one of which is the diaphragm.

The diaphragm is the muscular partition in the body separating the heart and lungs from the abdominal vicera, such as the stomach, liver, spleen, intestines, etc. In the case of a man apparently drowned, the diaphragm is unable to act and respiration ceases. Artificial respiration and the consequent emptying out of the water from the lungs is essential. In a case of electric shock the lungs are full of air, but the "stroke" or the flow of electric current acts on what physicians call the medulla oblongata, and affects the nerves from it so as to inhibit or stop the movement of the diaphragm. The medulla oblongata is at the base of the brain and is the part at the back, low down, near the neck. A man buttoning his back collar stud can by raising his hand up to the head, touch the place where this division of the brain is located. This region is the origin of the nerves which control involuntary action, such as the nerves which govern the action of the heart and of the diaphragm, which latter is most largely the cause of respiratory action.

The partially drowned man, and the man electrically "shocked" both have the diaphragm action stopped. In the first case it is like a clock whose pendulum becomes stationary because the hands are jammed. The second is as if the mechanism of the clock was free, but the pendulum had been arbitrarily stopped. In either case the pendulum must be made to swing again. In the human frame artificial respiration brings back the normal action of the diaphragm and the process of resuscitation goes on.

A pamphlet issued some years ago by the United Gas Improvement Co. of Philadelphia sets forth the procedure to be followed in case of electric shock. In it the patient is represented as placed upon his back. This is the supine position. In a treatise lately published by John Wiley & Sons, of this city, by Dr. Lauffer, the patient is placed face down. This is the prone position. Both methods have their advocates and both are effective.

The imperative necessity for prompt action by the man who would render first aid, becomes apparent when we remember that human beings have been able to live without food for forty days, and to subsist two days without water, but no one can be without air for more than two minutes without most seriously endangering his life. In these cases the victim is absolutely helpless, the friend who attempts to render help cannot take time to telephone or hunt up a physician, he must get to work on the instant. If he is fortunate enough to send for assistance, well and good, but in any case he must work, steadily, perseveringly and without cessation in the interest of his fellow man.

In all this the man who works unfalteringly must not measure his time nor his endurance. He must put success before him as the one, only, and paramount consideration. He must encourage himself in his efforts by the assurance of success, he must not stop to doubt. Who may say that the influence of his persistence and his will may not evoke a faint response in the helpless and stricken but still living friend to whom he ministers? The effects of individual rage or fright in a mob of people reveal themselves in the actions of many who do not see or hear the frenzied man, and may it not be that the action of what has been called "mob psychology," applied in a particular case, to a being who appears not to see or hear, yet may turn the scale or at least give him the full benefit of what power there is in resolute effort backed by the kindly thought.

A Glaring Menace

We call attention to the article on highway crossings in this issue, which will be followed by others on the same subject. We shall be glad to have comments or papers from our readers at any time relating to this present-day engrossing theme. The grade crossing, besides being a menace to vehicular traffic and the peaceful citizen who has a right to go that way, is unfortunately an invitation to the tramp and others who like the ties for a sidewalk, to invade the right of way, perhaps meeting death in the end or suffering serious injuries. The elimination of such crossings, for the latter reason alone, then, is of vital consequence. The trespass evil will to a large extent be thereby overcome, and that evil is today a public misfortune, as we all know.

Five thousand four hundred seventy-one trespassers on railroad property were killed in this country last year and 6,354 were injured. On the average, 16 trespassers are killed every day and 17 are injured—not all of them on account of invasions at the grade crossings, but a very large number of them. We referred to this evil and the suppressing of it at some length in our August issue of 1915, and in our November and December issues discussed the subject, especially referring to the separation of grades by the New York Central at Buffalo and by both the New York Central and the Pennsylvania roads at Erie, Penn. The stupendous work and expense involved in the elimination of grade crossings in Buffalo were apportioned by agreement between the New York Central and the city, and resulted in the separation of twenty-three streets. The whole operation was begun and finished within five years. This resulted in doing away with every heretofore dangerous crossing in the city, with the exception of two, so far as the New York Central was concerned, and this was a momentous accomplishment. At Erie an agreement has been consummated between the city, the New York Central and the Pennsylvania whereby, at an expense involving some $2,000,000 or more, twelve streets will be taken care of by eliminating grade intersections.

It will thus be seen that this matter is a live one and well worthy of consideration, from more than one point of view.

Comparisons Are Odious

That famous news sheet, the Springfield (Mass.) Republican, not long ago brought forth some interesting information regarding railroad speed, as far back as 1851. It mentioned that a contest was arranged, under stipulations as to load, fuel and steam pressure, to take place in October of that year. A half dozen locomotives were entered in this contest. The distance to be covered in the competition was nine miles.

A locomotive bearing the name of Addison Gilmore covered the distance in eleven minutes and twenty-nine seconds and won the prize. The achievement was referred to, in that day, as something performed in "hair-raising" time.

The other five engines trailed along, respectively, in this trial of speed, in 12 minutes and 50 seconds, 13 minutes and 26 seconds, 14 minutes and 7 seconds, 14 minutes and 35 seconds, and 14 minutes and 58 seconds. It certainly was hair-raising speed for those days, but special runs today and special portions of track, on regular runs, are covered with heavy loads behind the locomotive at rates of speed so far superior to the speed with small loads, attained in 1851, that we smile at the comparison, but sixty-four years hence results will undoubtedly show such comparisons with the present day speed that people living in that generation will have a chance to smile—too.

The Merchants Association of New York

This association has done a good many public spirited things the past year besides encouraging and advancing business affairs within its own particular circle. It has gone abroad in the cause of the railroads of the country in a way to merit more than ordinary commendation and in pressing the claim that the railroads are and have been grossly treated in the matter of compensation for carrying the mails they have stirred up an interest on this subject in pretty much every city of consequence in the land.

The resolutions adopted by the Merchants Association in this all-important matter have substantially been imitated, in addition to many others which have already taken action, by the Chambers of Commerce of Philadelphia, San Francisco, the State of Connecticut, Spokane, Washington; Eugene, Oregon; Zanesville, Ohio, and Springfield, Ohio. The good work is still going on. Associations like the Merchants Association of New York are of wonderful assistance, not only in promoting affairs of local interest, but in improving and instituting many matters of national importance. The railroad companies certainly owe this association a vote of thanks.

Electrolysis Mitigation

A paper giving a brief general statement regarding electrolysis and corrosion and presenting a detailed discussion of the various methods of electrolysis mitigation that have been proposed or tried for protecting underground structures has just been issued by the Bureau of Standards, Department of Commerce, Washington, D. C. There is no charge for this paper. Methods of mitigation are treated under two heads, namely, those applicable to pipes and those applicable to the railway return system. The conclusion is drawn that while certain of the methods applicable to pipes, particularly pipe drainage and insulating joints, are often valuable, they should in general be used as auxiliary measures only, the chief reliance being placed on reducing potential drops in the railway return to reasonably low values. Where return feeds are necessary for accomplishing this, insulated feeders are preferable because they are more economical.

Lift Bridge Over the Thomson River at Kamloops

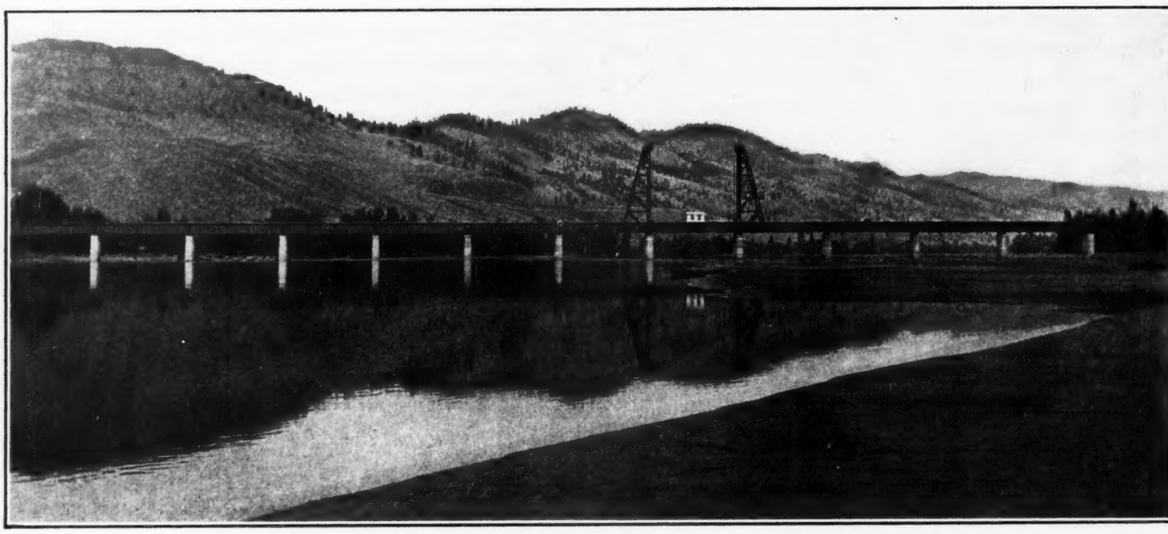
Thirteen Deck-Plate Girder Spans, with Lift Span at Channel, Giving 57 Ft. Vertical Clearance Above Maximum High Water

The lift bridge over the Thomson river at Kamloops, B. C., Canada, is in type like the famous Tower bridge in London, which was built from a fund held by the Bridge House Estates, an old institution which derived its original revenue from the sale of the properties and rights which once existed when the bridges entering any large town had shops built on them so as to secure traffic from travelers in and out of the city.

This type of bridge, applied to railway uses, has a moveable floor which carries the tracks of the road, and when in place in its lowest position forms one part of a long continuous bridge. The lift floor can be raised deck level so that the operator has a clear view of the river both up and down stream.

The bridge was designed and construction supervised by Waddell & Harrington, consulting engineers, Kansas City, Mo. The cost to the railway company of the bridge complete was about $250,000.

The lift span is counterweighted like an elevator in an apartment house or public building and when down in its lowest position it rests on the piers, and the weight of the train when crossing is carried on the permanent supports, like the rest of the bridge. When raised, the lift span is light and nothing more comes on the chains, gear, brakes, etc., than the unbalanced weight of the girders themselves. In this way the work of the hoisting engines is not excessive, and wear of parts is practically nil. For the kind of service to be performed, this style of bridge is eminently suitable, and its maintenance charge is not large.



Distant View of Thompson River Bridge, in British Columbia

by suitable machinery and engines from the lower level position to a height sufficient to permit the passage of boats and steamers below it.

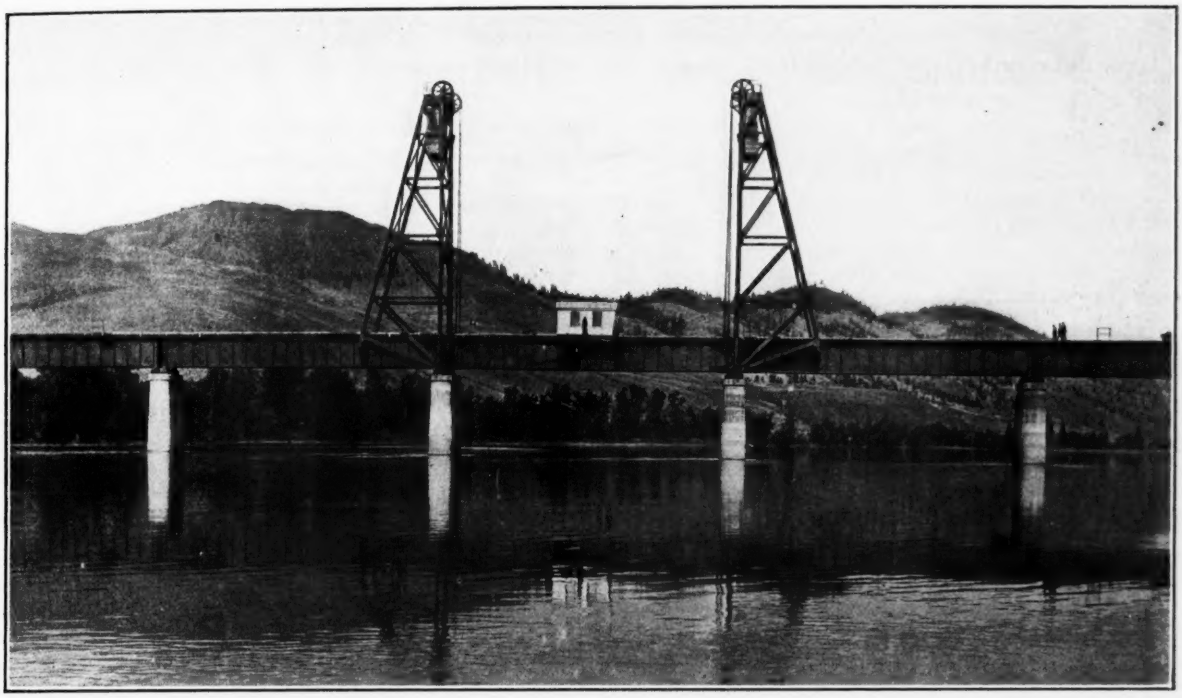
The Thomson river flows through hard sand and rock at this point and is in what is known as the grazing region of British Columbia. The river is navigable some distance below Kamloops and for a considerable distance above the bridge, so that the government requires navigation rights to be respected. The Thomson has two branches which join at Kamloops, one branch being known as the North Thomson and the other the Thomson. The North Thomson comes down through deep, impassable canyons, while the Thomson drains a series of mountain lakes.

The bridge is on the line of the Canadian Northern Railway, and consists of 13 deck plate girder spans 93 ft. center to center of piers. A movable span of the vertical lift type is provided at the channel and gives a horizontal clearance of 80 ft. and a vertical clearance of 57 ft. above maximum high water.

The lift span is operated by a 12-horsepower gasoline engine which opens or closes the span in a hundred seconds, that is, 1 minute and 40 seconds. The operating machine is located between the main girders, and below the deck. A small operator's cabin is located on the

Trust and Savings Fund for Employes

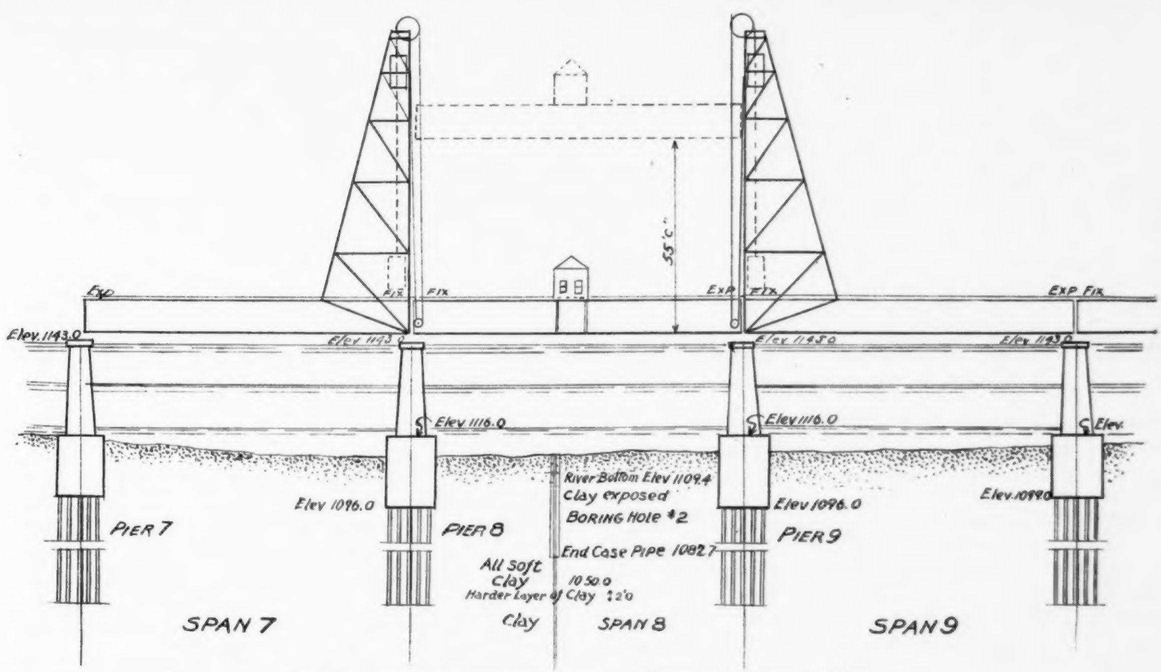
In line with railroad relief associations which we have heretofore mentioned, we find that the Westinghouse Electric and Manufacturing Company has recently established a savings fund, which offers facilities to its employes for the handling of their savings accounts. It encourages a spirit of thrift among the employes and cannot help but be of great benefit. The example of the Westinghouse Company is most commendable. The fund is open to any employe of the company, wherever he may be located, and he may become a depositor at any time and discontinue at any time. The amount of the deposit cannot be less than 10 cents and may be any multiple thereof, and the deposits must be made from each regular pay. The deposit, however, is limited to one account, the amount of which



Lift Bridge Over the Thompson River, Canadian Northern Railway

in any one year cannot exceed $500. The idea of this is that the plan is intended as a method of encouraging the employe to save his earnings and when he has been successful up to this point, allow him to handle his own finances. Interest is paid on the deposit at the rate of 4½ per cent., which is credited semi-annually.

An interesting feature of this fund is that the Westinghouse Electric and Manufacturing Company acts as a trustee and guarantees the deposits and the interest. The rules provide that an amount of $100 or less may be withdrawn, without notice, but an interval of two weeks must elapse before a subsequent withdrawal can be made and for withdrawals of more than $100 notice of one week must be given. An auditing committee, not to exceed seven persons, is to be elected by the depositors from among their own number, which committee shall be given an opportunity to examine the condition of accounts at semi-annual interest periods, the findings of which shall be published.



Outline Drawing of Spans 7, 8 and 9, Thompson River Bridge

The Magnolia Cut-Off on the Baltimore & Ohio Railroad

Lower Grades and Reduced Mileage Save Expense in Haulage. More than 3,200,000 Cubic Yards of Material Removed

On the eastern division of the Baltimore & Ohio Railroad the right of way is through a hilly formation for nearly 100 miles east of Cumberland, Md. To reduce the grade on a section where the up grade had such an incline that helper locomotives had to be placed in service to haul the freight up this incline, the engineers of the company planned and built a cut-off 11 miles in length which saves the expense of extra power for hauling, and adds more track-way for train movement. This route is known locally as the Magnolia Cut-off, and involves removing more than 3,200,000 cu. yds. of excavation, over 90 per cent of which is rock; the driving of four double-track tunnels with a combined length of 7,225 ft.; also the construction of two crossings over the Potomac river, with a total length of 2,054 ft., and the building of 5,200 lineal feet of concrete retaining walls.

In driving the tunnels drills operated by compressed air were used, the compressor or plants being contiguous to the work. The drilling in the Doe Gully cut was done by compressed air power drills. The three excavators ranging from 60 to 70 c. yds. capacity in ten hours, were of the Bucyrus, Marion, Osgood-Marion type with operating dipper bucket shovels $3\frac{1}{2}$ cu. yds. capacity.

Cut which Eliminates Tunnel on the Baltimore & Ohio at Doe Gully

The rock to be taken out of the open cuts as well as from the tunnels, was of a hard formation, necessitating the use of 40 per cent dynamite cartridges, inserted in holes bored by steam drills in the tunnel formation and by well drills in the open cuts, where the rock wall inclined from 45 to 60 degs. from horizontal. Thus the rock was shattered, to be removed by the excavators.

In constructing the bridges, the concrete was mixed on the banks, in revolving mixers, and the major portion was delivered to the towers by derricks and tramways, elevated, and deposited into the various units through chutes. The steel was erected without falsework, from the shore with a 50-ton derrick car, which loaded the material from the low level and placed it in position, moving outward as the work progressed. The field riveting was done with compressed air hammers. The average length of the girders was 100-ft. deck plate type, with 90 and 80-ft. lengths on the approaches, and where the Kessler bridge crossed the present line, it was necessary to use through girders, with ballast deck; the rest of the bridge being open floor. The dimensions of the piers were 8 by 35 under the coping. No floating plant was used for the work. Approximately 26,000 yds. of concrete were placed in the river bridges and 48,000 yds. in the retaining walls west of Kessler's and west of Paw Paw. All of this concrete was mixed in revolving mixers, one part cement, three parts sand, and five parts broken stone. The coffer dams were placed on the rock bottom of the river and carried to the height of ordinary high water. Ordinary sheathing was used with clay puddling. The reinforcement consisted of $\frac{3}{4}$-in. round rods with triangular mesh near the surface.

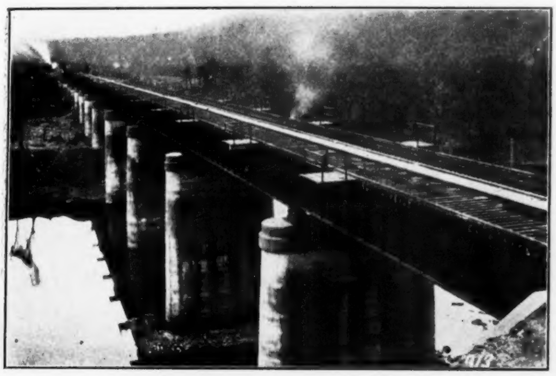
This work is estimated to cost fully $10,000,000, or $500,000 per mile, and will eliminate 5.95 miles of distance, and 377 deg. of curvature. It will also reduce the maximum grade against eastbound traffic from 0.5 per cent to 0.1 per cent, eliminating a grade 2.8 miles long, and releasing two pusher engines.

Starting from a connection with the old route a short distance west of Orleans Road, the new route ascends

on a 0.4 per cent grade to the west end of the present Doe Gully tunnel, and is being built as a four-track road to reduce the existing 0.55 per cent grade westbound. At Doe Gully tunnel the new route leaves the old and extends west generally parallel to it, but on a 0.1 per cent descending grade, for two miles to Hansrote, and is located on a bench adjacent to but considerably above the operated tracks.

At Hansrote the new route turns abruptly into the hill and after passing through Stuart tunnel crosses the present route and the Potomac river, passes through Graham tunnel, and again crosses over the river and the existing line. It then continues parallel to the present road for over a mile, but on a bench about 40 ft. above it. It passes through the southerly limits of the town of Paw Paw, and joins the old route at Little Cacapon; the 0.1 per cent grade being almost continuous from the summit at Doe Gully.

At Doe Gully a double-track tunnel was replaced by a four-track open cut, with a maximum depth on center line of 195 ft., and requiring the removal of 1,350,000



The Magnolia Bridge—Eleven Spans

cu. yds. of material, nearly all of which is rock, lying in strata tilted sharply on end. In addition to the amount and character of the material to be removed, the excavation of this cut was complicated by the necessity of keeping the present double-track tunnel in continuous service.

As shown in one of the illustrations, the material on the west side of the cut and over the tunnel was excavated by steam shovels to within 10 ft. of the roof of the tunnel. A vertical ledge of 16 ft. wide was then left west of the west wall, and the west half of the cut was taken out approximately to grade. A temporary double-track line was then laid through this cut for emergency use, in case the tunnel should be blocked during its removal. Because of the depth of the cut and the character of the material the slope on the west side has been benched at intervals of 50 ft. vertically, while the opposite slope will be treated in the same manner after the tunnel has been removed. These benches are designed to afford drainage and to prevent slides, and have been built on grades of 3.2 and 1½ per cent on the upper, middle and lower levels, respectively. The material from these benches was wasted at the elevation of the benches at the ends of the cut.

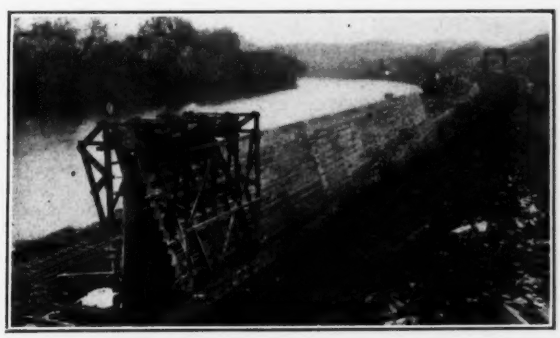
Immediately west of Doe Gully the new route passes through a hill by means of a tunnel 1,025 ft. long, known as Randolph tunnel. This tunnel is located on a 4 deg. curve. Here a top heading 9 by 16 ft. was first driven. Following this a model 20 Marion air-operated shovel widened the heading to the full arch section. The bench was then removed by a large shovel. The arch was lined with timber as the excavation progressed, and this was replaced with the permanent concrete lining as soon as the steam shovels had completed their work.

The standard lining consists of concrete up to the 25 deg. line, faced with one course of brick above this

Three Engines Working in Cut on Magnolia Cut-Off

point. To secure a bond with the concrete, every fifth brick was made a header. Blaw steel forms were used. Refuge niches were inserted on each side at intervals of 100 ft., and cable and switch boxes were placed 300 ft. apart.

One of the most interesting portions of the work is that from the tunnel southerly 1½ miles to Hansrote. Between these points the new route is closely adjacent to the exisiting route and on a bench above it. Because of this close proximity it was decided to shatter the formation with explosives where the material is not being excavated by steam shovels, forming benches not to exceed 8 ft. in depth, and the waste was dumped into ravines at the level of the different lifts. A considerable amount was so placed on the river side of the present tracks to permit these tracks to be extended laterally at certain locations, in this way reducing the



Magnolia Cut-Off Looking East from Present Tracks, Showing Smith McCormick's Wall

maximum degree of curvature from 5 degs. to 3 degs. At Hansrote the new route leaves the old and turns abruptly into the hill, crossing the mountain divide through Stuart tunnel 3,600 ft. long. The east approach to this tunnel required the removal of 205,000 cu. yds. of rock. About 90,000 cu. yds. of similar material was removed from the west approach. At the latter point considerable difficulty has also been encountered in establishing the portal, because of the sharply inclined and badly broken strata. This tunnel is constructed on a tangent, except for 371 ft. of spiral within the east portal.

This tunnel was driven from two shafts 117 and 40 ft. deep, also from the west portal, the east approach cut not being completed in time to enable a heading to

be driven from the east portal. As in the Randolph tunnel, 9 by 16 ft. center headings were first driven, working in this instance from five points. These headings were widened to full section by hand, except for the first 1,000 ft. in the west heading, where a 20-Marion shovel was also used.

With this shovel it was possible to widen and timber 60 to 70 lineal feet of the arch section per week, as compared with 45 by hand work. The shovel also removed 6 ft. of the bench at the same time, to secure the necessary working clearance. The bench was then taken out with the large shovels. Because of the difficulty encountered in establishing the portal at the west end and the uncertain character of the material at the east portal, the center heading was driven from the shaft to within 72 ft. of the east portal, at which point it opens into two wall plate drifts. The entire arch section was then removed for 30 ft., after which the wall plate drifts alone were driven, leaving the center support for the roof for 42 ft. in from the portal, until the portal was turned. Both steel and timber centers were used in this tunnel, the steel being used where especially loose rock formation was encountered, while the wooden centers were employed elsewhere.

A short distance west of Stuart tunnel this new route crosses the old, at Magnolia station, continuing across the Potomac river, passing through a point in a tunnel 1,600 ft. long, and then recrossing the river and the operated line, all in a distance slightly over one-half mile.

The bridge at Magnolia consists of six 100-ft., three 80-ft., and two 75-ft. deck plate girder spans on concrete piers, with the new grade 50 ft. above the old route and 60 ft. above the water. The viaduct at Kessler's curve consists of four 100-ft., and six 75-ft. deck plate girder spans with three skew girder spans over the old route, with a combined length of 202 ft., 6 ins. Both structures are designed for Cooper's E 60 loading.

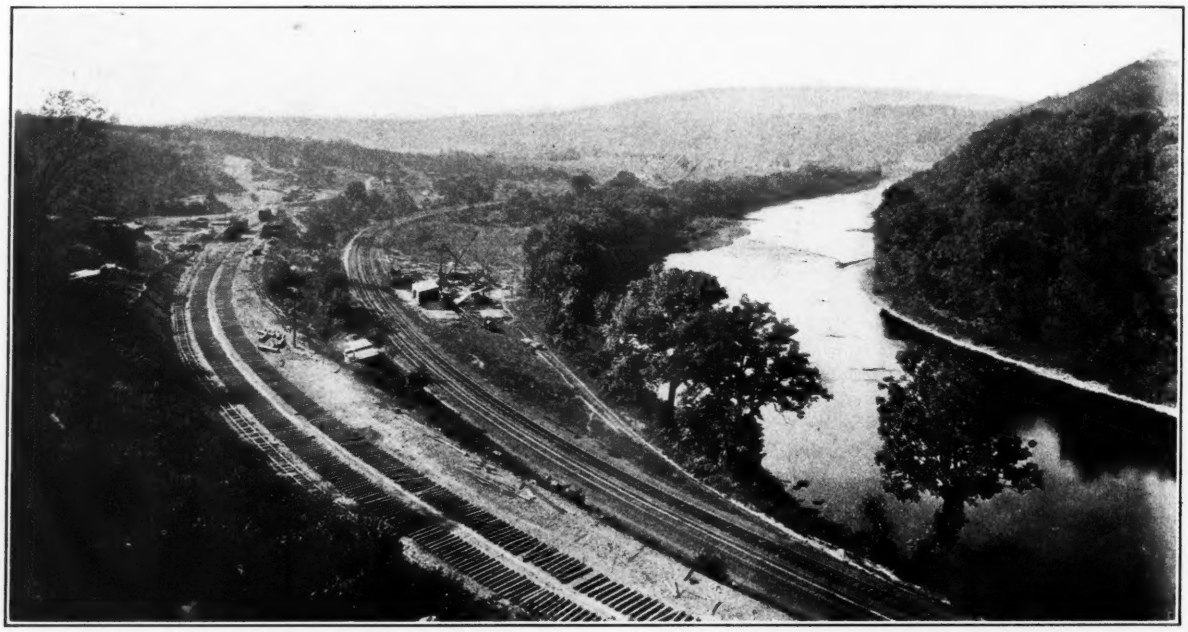
The piers for both structures are founded on rock about 5 ft. below the river bed, and one of the views we give shows clearly the different steps in their construction.

The route of the cut-off west of Kessler's bridge required a concrete retaining wall along the shore of the river between tracks. This wall is of gravity section, non-reinforced, and with a maximum height above the footing of 31 ft. The elevation of the top of footing is 3 ft. below the top of the rail of the lower line. The construction of this footing has been a difficult engineering problem, as in some cases it has been necessary to go as much as 14 ft. below the top of the footing to secure a proper foundation, while in other cases it has been necessary to remove a 40-ft. rock face to secure sufficient bench. The top of the wall is 4 ft. above the elevation of sub-grade of the new route.

This wall required the placing of 22,000 cu. yds. of concrete, deposited by means of a movable traveler spanning the two main tracks. The traveler was of steel construction with a horizontal clearance of 32 ft. 9 ins., and a minimum vertical clearance of 23 ft. 3 ins. above the high rail on curves. Two derricks with 50-ft. booms and two boilers and hoisting engines were placed on the upper platform. In this way all excavation for the wall footing and the depositing of the concrete was handled by the derrick without interfering with the main track and without any material crossing the tracks at grade. The forward derrick conveyed the excavation ahead of the wall, while the other one deposited the concrete. When removed from one section of the wall to the next, the forms were lifted free of the completed work. The traveler moved on two rails, supported on timber blocking. The wall was built in 50-ft. sections, and a section could be completed in two days.

A short distance west of this wall the new route passes through the southerly limits of the town of Paw Paw. Shortly after leaving the main line the new railroad passes through Carothers tunnel, 1,000 ft. long. The material encountered here and the methods of driving are similar to those described as used at the other tunnels. One of the largest cuts on the line was at Paw Paw, where over 500,000 cu. yds. of material, largely earth, was removed. The maximum depth of the cut at this point was 96 ft.

This material was hauled west to a point where the



View of Construction Work on the Magnolia Cut-Off, on the B. & O.

old route is to go towards the river, and be graded to allow space for a four-track line, and at the same time to raise the grade of the old line above high water. A portion of this new fill extends into the river, and to protect it from being washed out by flood current, another retaining wall, similar to that east of

End of Retaining Wall, West of Kessler's Bridge

Paw Paw, was constructed for a distance of 3,300 ft. This wall has an average height of 24 ft. and was built in the same general manner as the wall previously described, but here, as it was not necessary to span any tracks, a wooden traveler was provided to carry the forms only, and the concrete was deposited with a locomotive crane. Two sets of steel forms were provided for 30-ft. sections and these were used alternately. About 25,000 cu. yds. were required for this wall.

This illustration of engineering ability in perform-

Middle Bench of Doe Gully Cut

ing a very difficult work, was planned by the chief engineer, Mr. Francis Lee Stuart. It was carried out by Mr. John T. Wilson, district engineer, and Messrs. Errett M. Graham, T. C. Marshall, and Tazewell Ellett, Jr., resident engineers. The total force employed was approximately 2,500 men, and the total cu. yds. excavated was 3,300,000.

Temperature Influence on Concrete

Some very interesting and informative tests on how far temperature may influence the attainment of strength in concrete were carried out a short time ago at the University of Illinois. Three groups of tests were made, the first on forty-five cylinders 6x6 ins. The second group was on fifty-one 6-in. cubes and the third on cylinders 8x16 ins. The quality of the materials are considered as typical of that used in first-class concrete work in the Middle West. The cement taken was Universal Portland cement, which passed the standard specifications of the American Society for Testing Materials. The sand used was from a deposit of glacial drift near the Wabash river at Attica, Ind. The stone was crushed limestone from Kankakee, Ill. It had been carefully graded and screened over a ¼-in. mesh before use. It contained 10 per cent of material smaller than one-quarter of an inch.

The concrete tested consisted of one part cement, two parts sand, and four parts of broken stone, and is represented by the figures 1, 2, 4. The materials were weighed separately and then mixed on the floor with shovels. The test specimens of Group 1 were weighed measured, their bearing surfaces coated with plaster of paris and left in the testing room for 20 hours in a temperature of 70 degs. F. Group 2 were tested an hour after being brought from storage in a temperature of 70 degs. F. Group 3 were similarly treated. In group 2 two specimens were subjected to special treatment. In standardizing the strength of specimens the observed values of cubes and cylinders were brought to what may be considered equivalent values, such as would be obtained from cylinders with height equal to twice their diameter. The observed values were multiplied by 0.73, which is the ratio of strength of prisms to cubes as determined by the Committee on Specifications and Methods of Test for Concrete Materials, of the American Concrete Institute.

The bulletin of the university, which is No. 81, thus summarizes the general conclusions which it is thought to be justifiable from the mass of data secured, the tables compiled and the curves plotted as a result of the experiments. It may, however, be pointed out that groups 1 and 3 were tests of cylinders 6 and 8 ins. in diameter, and 6 and 16 ins. high, respectively. Group 2 was concerned with cubes 6 ins. a side. The report states that owing to the effect of the restraint of the pressing surfaces of the testing machine, the results of these tests were not considered. It is therefore on the information secured by the testing of the cylinders that the value of the conclusions rest.

The report says in effect that under uniform temperature conditions, there was an increase of strength with age within the limits of the tests. For any temperature the rate of increase decreases with the age of the specimen; and this rate of increase is less correspondingly at the lower temperature conditions. For the specimens tested, under normal hardending temperature conditions of from 60 to 70 degs. F., the compressive strength of the concrete subjected to a uniform temperature at the ages of 7, 14, and 21 days may be taken as approximately 50 per cent, 75 per cent, and 90 per cent of the strength at 28 days, respectively. For lower temperatures the percentage values are less; and for higher temperatures the percentages are higher. The relation between the percentage values at the ages of 7, 14, 21, and 28 days is nearly the same for temperature conditions from 30 to 70 degs. F. The values for the lower temperatures should be used with caution. Concrete which is maintained at a temperature of 60 to 70 degs. F. will at the age of one week have practically double the strength of the same material which is kept at a temperature of 32 to 40 degs. F.

The figures given in the report as Nos. 15 and 16, it is stated, may be used to determine the representative strength of concrete similar to that used in these tests, for various temperature conditions and for ages up to 28 days. It should be noted that generally in this investigation the specimens were stored under temperatures which were nearly uniform during the whole storage period. In a particular set, designated as F, the variations in temperature include a number of alternations above and below the freezing point and the specimens were seriously injured. The results accord with the well-known effect of freezing and thawing upon green concrete.

Formation and Prevention of Pockets and Soft Places

By C. A. DAVIS

The Importance of Attention to Drainage in the Early Construction of Railroads and in Track Maintenance Work from Year to Year

There are three important things to be considered on the subject of pockets and soft places: 1st, the cause; 2d, to prevent, and 3d, to check them after once formed. The statement in your editorial in the July issue, is true, that improper construction and placing of material in the first place, gives a start for pocket formation and soft places that may not become fully developed for a number of years and yet be the direct cause of what has cost railroads millions of dollars and many deaths, and loss and damage caused by wrecks. Years may have elapsed since the construction work was first done, but this defect can be readily traced back to where it started. The smaller the fault the longer period will elapse before it can produce noticeable trouble.

In order to confirm this statement it becomes necessary to show the oversight or erroneous theoretical belief adhered to, while the construction of the road bed was going on. The theory demands most rigid investigation, in order to right the theory and also overcome many of these soft pocket places, by preventing their first formation. I can safely say that a large number of pockets and soft places are the direct cause of poor grading and the way the grade was finished, although part was the fault of bad track laying and surfacing, but most of the pockets were not formed when grading was started. Grading and ballasting are done in accordance with theoretical instructions more than the placing of material. This I cannot call anything but defective theory that soon develops into trouble and it takes thousands of dollars to maintain a passable track but rarely a safe one, at all times.

On all grade work stakes are set and the work completed and accepted before permission is given for track laying. It is well known that the crown of the grade varies but is invariably made level on top, this being one of the greatest causes of future soft spot and pocket formation together with the grade and class of earth put in. The kind of earth has the largest part chargeable to it, on account of the flat finish. It is evident that earth with large lumps will be more open and after a few rains become soft, and the clods will soon pack and cause a lower place in the grade than where the earth was more fine and loose. This produces an uneven surface and makes places that may only retain a small quantity of water, yet this will be enough to start a soft place and instead of becoming smaller it will increase until it becomes of troublesome and, by improper repairing, soon develop into a serious pocket formation.

These troubles could in a great measure be prevented if only a practicable result was considered, regardless of theory in finishing the grade. If all grades were finished with a rolling top it would cause water to run off, leaving the crown dry after all rains, which would prevent any formation that would hold water for a pocket-starter. There cannot be any practical and observing track-man but will back up my statement that a large per cent of these pockets and soft places could have been prevented if the grade had been so finished that these pockets could not have got a start. To further condemn the flat-top finish it is only necessary to state that when the track is laid as near the center of the grade as is practicable, there is an enormous weight on about 8 ft., while there is from 4 to 6 ft. without any additional weight extending from the end of the ties each way to the edge of the grade on fill and in cuts. This will cause a much faster settling under that part covered by the track than that out at each side, thus forming a trough instead of a shed as should have been done.

This defect is not so prominent that an official passing along would observe, if it was anything out of the ordinary, but any practical man who is looking for cause and effect can see this condition, and ofttimes tries to remedy it by cutting down the shoulder and casting the earth off to give better drainage. This succeeds to a certain extent and gives some relief, but it does not always accomplish what is desired. As grades are made over an undulating section, this trough is formed, and water accumulates. It follows down a descending grade and where there is a raise it will so accumulate in front of it and form a regular boggy soft place that if not properly handled will require tiling or course stone so placed that the water can escape, but this will only give partial relief, for the trough still exists and causes a disturbance after each wet spell.

It is not an uncommon thing to see on newly made grades before the track is laid, where water has run for some distance before leaving the surface and when it does, will wash the earth in the cut ditches or off the edge of fills, then how can any better results be expected after the track has been put down and the lowered condition caused by this additional weight. The only noticeable difference is that the water has to zigzag under and around the ties, thus covering a greater surface and making a much wider wet place than when running without meandering among the ties and permitting much more water to settle in the ground, leaving no visible trace, but the track will get out of surface and line.

Thus we find the first and original starting of what in later years will develop into troublesome pockets and soft places which could have been prevented had theory been sidetracked. This would not have cost one penny more at that time and would have saved many thousands of dollars later on and give a much better track and one that could have been maintained at a much less cost. This is not an opinion of my own, but the result of close observation on many miles of new track that I have had charge of from the first start in grading through track laying and ballasting, not at any one place but in four different States—with the same result in each. Most if not all these conditions could have been prevented had the grade been finished with a raise of about 6 ins. descending to the outer edge, and by being positive that there is no place where water could accumulate and stand before the track is laid.

After the track is laid and settled we have the proper drainage as the shoulders will be sufficiently low to give a perfect drainage from the end of the ties if they are properly laid and surfaced. I can give over fifty different locations where track was rushed on new grade with the same result and almost all soft pocket places had the same origination. I will give the reason for

their formation; namely, the placing of crooked ties with the bow down, especially if a pole tie made from a young tree just large enough to make one tie. When these are laid bow down there is no possible way to prevent water from gathering at the center, and it is bound to produce a softer point than at other places. A split tie may be bowed to a certain degree, but if the heart side is put down it will invariably become straight as soon as the weight is put upon it, and cause no bad results.

The first surfacing has a lot to be charged to the soft spot, but it is not noticeable at first. That is by tamping up the end of the ties and filling in and dressing up regardless of whether there is anything under the center of the ties or not. This to a certain extent is the result of too much rush work and a desire to make a record. Track surface made in this hasty way will soon fill with water and soften the center so that it will cause untold trouble before it is overcome. If track is properly laid and surfaced, a large percentage of the defect chargeable to construction would be overcome, and it would cost but a trifle more, if any, at that time, which would make a large saving later on. The track should have about 4 ins. raise, and every tie should be tamped and filled underneath and then filled in and so dressed that water will run off, and if all surplus earth that is on the shoulders is not utilized it should be cut away and thrown out so that there would be a drain at all places.

There cannot be too much attention paid to the first surfacing filling and dressing of new track if good and lasting results are to be obtained, which is the desire and expectation of every one who has the permanent maintenance to look after. This is the effect, cause and remedy for the principal part of the soft pocket formation.

We now proceed to the next cause and effect brought about in applying ballast. I will say that there are far more pockets and soft places made while applying ballast than many believe, yet it is nevertheless true, that by strict attention and careful watching for developments after a track has been put up on ballast in first class shape, that it becomes apparent. Stakes are set and instruction given as to how high to raise and what work must be done in preparing track for ballast, and right here in the preparing I have found the main cause, and have seen, to my sorrow, the effect, after a piece of track has been put up on ballast and dressed and looks perfect, and should be satisfactory in every way for years to come, but faults will soon develop and give an endless lot of trouble. Now the instruction is to throw out all earth from between the ties before ballast is unloaded, and as a general rule it is done, but right here arises the question with what future results? Let us take an observation as to how it is done and see what is hidden when ballast is distributed. It is very easy to get the earth from between the ties inside the rails, but from under the rail is more difficult, and is entirely too often left, with only a small portion, if any, taken out. Now if the rest was only taken out as low as the bottom of the ties it would still leave a ridge under each rail, forming a trough; but this is not the worst. Almost invariably the earth is dug out below the tie bed in the center, for several inches, thus forming a small receptacle for water to stand, and the ballast completely hides it from view; but later years will develop a pocket or soft place, with no other cause than this preparing for ballast.

I have seen miles of this kind of work done, and later on had charge of this division and examined and fought hard to overcome the trouble, which I did to a certain extent; but not what should have been done, as it was so costly that I could not get the material and help that was required.

At the time this track was being ballasted I had charge of another division, and was given all the ballast that I considered necessary, and permited to make just what raise I considered necessary to give a permanent piece of track without having a grade stake set, or any instruction as to how the work had to be done. Instead of casting out the earth, as theory said, I distributed the ballast after cleaning off the shoulders and gave the track a good raise, tamping the ends with ballast, and then pushing the earth in the track down in the old tie beds and to the center of the track, which made it something like 4 ins. higher than out at the end of the ties. Then I unloaded more ballast and gave not less than 8 ins. raise at any place, and using a spot board brought up the rest of track to these points, with the result that there were no weak spots. There was 40 miles of this work, and I can say that for three years after, while in my charge, and for years following there had not been any pockets or soft places develop. The foreman on the adjoining division had the earth thrown out, and he had pockets and soft places develop all over the division.

But of these facts are there enough to prove or disprove these statements? There is no foreman that ever put up ballast but will say that after throwing out the earth and raising the track that there are old tie beds that are much deeper than the rest of the earth, and when ties are spaced this old bed often comes entirely out from under or at most partially comes out from under a tie which makes an uneven bed of gravel, permitting the tie to cant and work toward the weakest place, and at the same time this old bed being packed down solid will retain water almost like a pot or pan. This being the true condition, how can there help being soft and pocket places form, and instead of diminishing they grow gradually larger after each rain until they become so enlarged that it takes work, material, and a large outlay of money to overcome them so as not to develop in later years.

There is a mixture of ballast, mud and water several feet deep and if on a level tract of land this new formation is far below the surrounding surface of the land. To get relief from places like this it is frequently necessary to tile for several hundred feet to get a drainage to carry off the water.

To further present a proof where improper preparation was at fault, although done strictly in accord with stakes and theoretical instruction, we will take a 40-mile road, now a main line of the A., T. & S. F., but at that time was not owned by them. There were eight work trains widening cuts, making ditches and shaping up fills preparatory for crushed stone ballast. At all places the earth was left or placed so that it would be level with the top of the ties, the earth in the track shoveled off and ballast put in. Now it can readily be seen that where the old ties had lain that there was a receptacle for water as large as the tie, and this being in gumbo the ability of such earth to hold is well known.

The track was given a good raise, ties spaced, a all additional ties necessary to make a good substanti road were applied, but what was the result? In les than 18 months there was almost as soft and rough track as it was previous to ballasting, and for years there was not a mile out of this forty that could be called good track, being filled with pockets and soft places the entire length. All this was for no other reason than the manner in which the preparation and applying of the ballast had been done.

There are only two ways to check soft or pocket places and that is to make such drains as will carry off

all water, or to seal with some material so that water cannot penetrate. Coarse ballast will never give lasting results, but on the other hand will make a continual demand for more, and the cost of applying the same is heavy. A great many pockets can be filled by throwing out all the ballast during dry weather and filling in earth until the defect is as high or higher than at the sides, then placing the ballast back; but this takes time and careful work and watching to get permanent relief, yet it can be done.

The work of overcoming soft places and pockets is entirely governed by the locality, but first of all drainage must be made so that water cannot stand at these places, and when that is done the greatest obstacle is removed.

The most important thing is to know the cause or origin of the soft spot and then see that it does not exist, as prevention is better than cure.

The Significance of the Overlap

A Discussion of the Overlap from the Standpoint of Safe Operation

In automatic block signaling there is an important arrangement of track circuit which is known as the "overlap." When a train enters a block it makes the home and distant signals at the entrance of the block assume the danger and the caution position, respectively. The distant signal so standing does not go to clear when the block is vacated, because it works in unison with and duplicates the action of the home signal next ahead.

To be more specific, when a train enters block A, both home and distant signals at the entrance of this block go to the stop and caution positions. When the train leaves block A and enters block B the home signal at A goes to clear, but not so the distant at A. This signal remains at caution as long as the home at B is at danger, and clears only when the home at B clears. The entrance of the train into block A puts the distant at A at caution, but the train must actually be in block C before the distant or caution signal at A will go clear.

This provides important information for the enginemen as they enter block A. The signals say to them, the block at A is open to you for the home signal is clear. It also informs them of the condition of block B, according to whether the distant at A is found, as they enter block A, to be clear or in the caution position. With this knowledge supplied to them by the operation of an automatic device they must govern themselves and decide on their behavior.

The overlap is, as we have said, an arrangement of the track circuit, and it is designed for a special purpose. On entering block A both home and distant signals assume the position "against" a following train. If the train in question pulls into block B, say 50 ft., it is protected as far as mere semaphore blades and lights are concerned. Suppose the train stops there for some reason. If there was no overlap the home at A would clear, through the distant at A would remain at caution.

It is possible under these circumstances for an engineman to make a mistake or miscalculate and enter block A, observing the cautioning distant signal at A, and yet travel at such speed that the home signal at B might be seen or its indication acted on too late to avoid a rear collision. Such a thing ought not to happen, and the rules provide that it shall not happen, but on a railway, as we know it, there is always the possibility of some one going wrong, and it is that ever present menace to safety which causes the use of automatic appliances, and the constant and laudable endeavor of the officers of a railway to keep up the moral tone of the employees by a conscientious regard for the life of others. In this it is only fair to say the rank and file of railroad employees heartily and ably cooperate.

The overlap is so arranged that if the train stopped, say, a few feet inside block B, the home signal at A would not clear. The overlap is designed to cover some appreciable distance, say 600 ft. or over, according to grade, curvature, or other physical peculiarities of the track. The whole arrangement is practically equivalent to saying that the influence governing the home signal at A overlaps block B for 600 ft. or more. A train entering block B runs say 600 ft. past the home signal at B before the home signal at A will clear.

In practical everyday life on a modern railway the overlap has the advantage of thus being an important safety device. It is true that the rules provide for there being no rear collision, but the question may fairly be asked, Would you feel perfectly safe and contented if you sat in the rear Pullman on a train stopped just inside block B, with the signals almost over your head at "stop" and the home at A clear, permitting a fast train to enter the block you had just left?

The engineman on the following train is warned by the distant signal A, and was told as plainly as railway semaphores can say it,—"The home signal at B is against you, prepare to stop now." He thus has one whole block to provide for the many possibilities and contingencies that may and do constantly arise—wet or dry or greasy rail, variation in the holding power of brakes, obscuration of the lights at night, adverse and fitful weather conditions. All this is contemplated in the rules and they should be implicitly, faultlessly and vigorously obeyed. The overlap does not supersede the rules, nor does it modify their absolute and binding character of their announcement. No amount of false reasoning can substitute right for wrong, and special pleading can not make black look white.

The signals stand for certain things, neither more nor less, they do not beg nor plead. They state facts. Yet while human nature remains what it is, the overlap constitutes additional security which will give a man one more last chance for safety in the happily remote case that he has miscalculated or has been momentarily distracted or has been slow of action. Signaling is one of the most supremely important branches of railroad work, and although the ingenuity of the engineer has brought it to a high state of mechanical excellence, it devolves upon the signal engineer and his staff and the road master and his staff where they have the maintenance of the signal system, or are even remotely related thereto, to thoroughly grasp the meaning and the significance of each detail, so that they may know, when derangement or failure of the mechanism occurs, what serious consequences it involves and thus intelligently apply their knowledge and ability to the work of adjustment and repair to that commanding appliance upon which the lives of others are so directly and specially dependent.

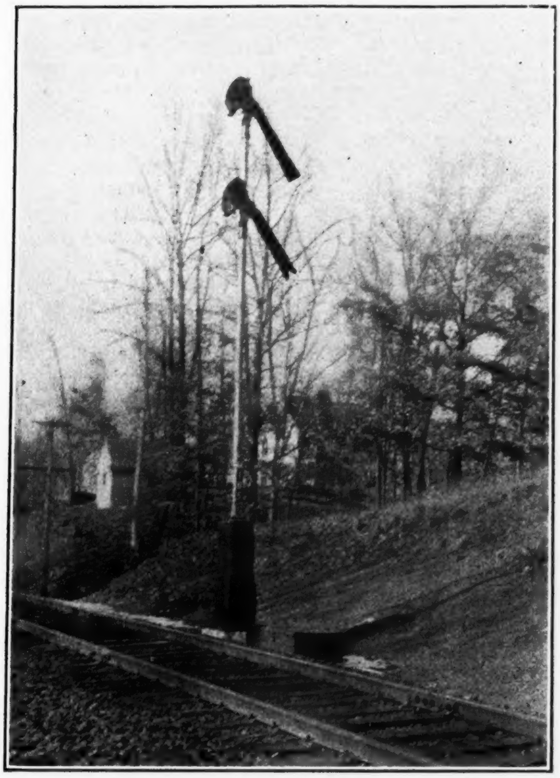
American Concrete Pipe Association

The annual convention for 1916 of the American Concrete Pipe Association will be held in Chicago, February 17 and 18, during the week of the cement show. A programme of unusual interest has been prepared, covering different topics of importance relative to the manufacture and sale of concrete sewer pipe and drain tile. Among the speakers will be Hon. A. O. Eberhart, ex-Governor of Minnesota.

Up-Grade Signals on the Delaware Lackawanna & Western

New Method of Dealing With Permissive Signaling Involving "Discretionary Obedience" by Which Delay to Traffic is Eliminated

The Black Rock Branch on the Buffalo Division of the Delaware, Lackawanna & Western Railroad has been signalled with semaphores worked on what may be called the permissive system. The semaphores, both home and distant, on the masts of up-grade signals are painted yellow; and the night indications are also given in yellow. This of course, permits an engineman to proceed under caution, to the next block, otherwise,



Permissive Signals, D., L. & W.

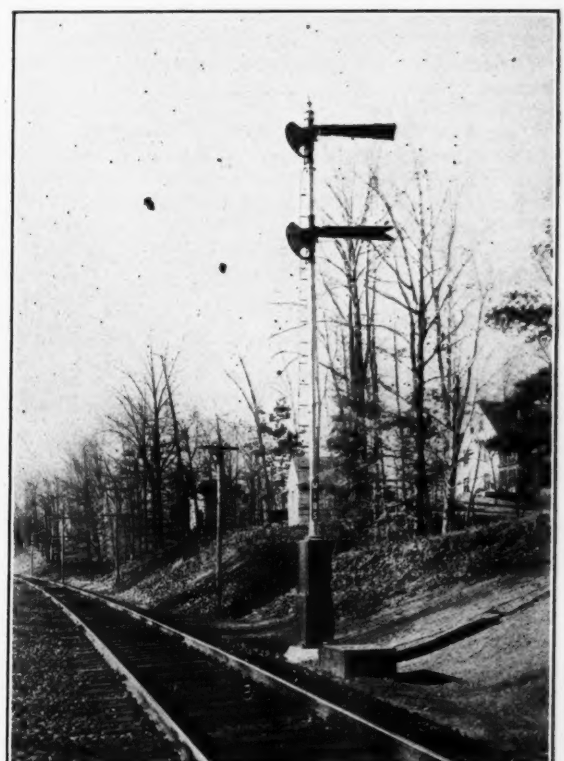
if a red day or night indication is given, the engineer would be obliged to stop, and in doing this on a grade of anywhere from 45 to 70 ft. to the mile, it would be difficult to start the train again without the aid of a pusher, hence the desirability of using the yellow or up-grade signals on this portion of the road.

There is on this line about 30 miles of such signalling, and the maximum grade is 79 ft. to the mile. A copy of the bulletin for the guidance of the enginemen and others when putting these up-grade signals in service has been issued and the circular reads as follows: "Eastward home and distant signal K-4134, located just east of the Erie and Black Rock crossing, and westward single arm home signal K-4125, located 8-10 mile east of the same crossing, will display a yellow or caution home blade by day and a yellow light by night. When the blade is in the horizontal position or a yellow light is displayed, enginemen may proceed under absolute control, to the next block ahead, without stopping at the signal.

"Enginemen of any train entering a block under this restrictive indication, as provided by the rules, will be held responsible in case of any accident on account of the block being occupied. These signals will be operated in accordance with rules governing use and operation of automatic block and interlocking signals, which became effective December 16, 1900. The placing of the blades on the signal masts will indicate that they are in service."

The principle here involved is one in which practical expediency has provided a method of working; under the circumstances. The blades of the semaphores both painted yellow, the "home" being square on the end and the "distant" having the usual fish-tail. No red signal day or night is used, because a stop is not required. This does not require an engineman to pass or disregard the red, imperative, stop signal.

We have before now alluded to the fact that a "home" signal is not of necessity and of itself an order



Permissive Block on Grade, D., L. & W.

to the engineman to stop. Custom and what is considered good practice require the stop, hence the red color used, and it is quite right that it should be so under normal conditions, but the fundamental point as indicated in this installment is that the signal is an "information giver" upon which the engineman is expected to act with common sense and due regard for conditions.

To stop a heavy train on an up-grade might entail delay and more or less extra work by a pusher. The

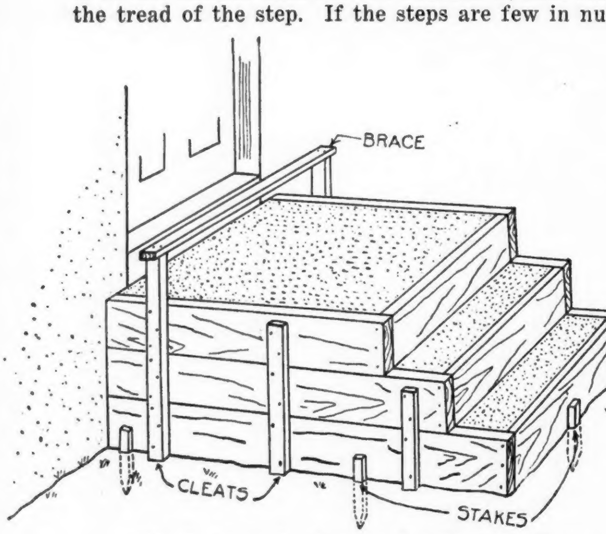
enginemam is therefore permitted to proceed with the warning given by the horizontal yellow signal blade or yellow light at night. Such a condition may not involve danger or accident and depends largely on how faithfully duty is performed and how fully responsibility is accepted. The signal system here described covers a special territory and is designed for extranormal conditions, yet at the same time it recognizes the fact that enginemen are capable of accepting responsibility and acting with the idea of "safety first" always before them. In this their performance approximates to what in other lines of activity has been called "discretionary obedience."

Simple Concrete Steps

Method of Constructing Forms and Pouring Concrete for Inexpensive Steps

Steps are not only subject to hard usage, but when made of wood with the lower part in contact with the ground and subject to alternate wetting and drying, brings on decay very rapidly, making it unsafe and dangerous. A simple method of making them is shown in our illustration. The three forms consist merely of that many boxes open at top and bottom and also at the end adjoining the door-sill.

A rise of 8 ins. and a tread of 10 ins. will be found convenient. For this reason the height of each box should be 8 ins., since every box will form a step. All of the boxes should be of the same width, but each one is 10 ins. shorter than the one beneath it, thus forming the tread of the step. If the steps are few in number



Simple forms for Constructing Concrete Steps

and not too wide, 1-in. boards will be stiff enough to hold the concrete without bulging, but if there is any doubt about this it is better to use 2-in. plank. The concrete for the steps should be mixed in the proportion of 1 bag of Portland cement to 2½ cu. ft. clean coarse sand to 4 cu. ft. of crushed rock or pebbles. The earth beneath the steps should be excavated to a depth of 6 ins. below the surface, the excavation being the exact size of the bottom of the steps. The earth should be level and compact at the bottom of the excavation.

Place the largest box in position around the edge of the excavation, staking it in place at two or three points to prevent shifting. Level the first box very carefully by means of a carpenter's spirit level. The concrete, mixed rather dry, should be deposited in the box and thoroughly tamped and compacted until moisture rises to the surface. Work the concrete thoroughly along the sides of the forms so as to produce a smooth surface. At the front end of the box, where the concrete becomes the tread, the surface of the concrete must be carefully leveled off and smoothed with a trowel for a distance of about 12 ins. from the outer edge. Immediately after this is done the second and smaller box is placed on top of the first one, being fastened thereto by a few nails through the upright cleats shown in our illustration. The nails must not be so long as to project through the forms and into the concrete. Fill the second box with concrete immediately, being careful that no dirt or other foreign matter collects on the surface of the first batch of concrete, as this would prevent a good bond between the two layers. Finish this step in exactly the same manner as described for the first step. The last or third step is constructed in exactly the same manner as those previously described.

The brace between the two back cleats is for the purpose of preventing the boards from spreading at the side next to the wall. The outer surface of the top step is carefully leveled off with a straight-edge and finished by troweling to a smooth surface. Not more than a half hour should elapse between placing the concrete for each step so that the concrete first deposited will not harden and set before the next form is filled. After the steps are about a week old, the forms may be removed and the steps used. After the forms are removed any roughness or irregularities may be smoothed down and the surface of the entire steps be finally finished by rubbing with a piece of emery wheel and water or carborundum and water. Where the work includes many steps, a hollow space is generally left under the main body of the steps to effect a saving in materials. Where this is done the platform and steps are reinforced with steel rods or heavy wire mesh to prevent cracking. Steps such as these are useful on railways, at office and shop doors, etc.

Accelerator for Hardening Concrete

Experiments have been made by the United States Bureau of Standards, says a recent commerce report, to develop a method for accelerating the hardening of concrete, in order that the material might be used in revetment work in place of the willow mats that have been used in the past along the Mississippi River. The Bureau finds that 4 per cent of calcium chloride added to the mixing water increases the strength of the concrete at the age of one day 100 per cent or more. In some cases the strength of the concrete in which the calcium chloride was used at the age of two days equaled 75 per cent or more of the strength normally attained in one month. The Bureau of Standards believes that the findings of this investigation will be of appreciable value in concrete construction. Further information may be had on application to the Bureau at Washington, D. C.

Railroad to Argentine-Bolivian Frontier

In order to act in harmony with the Bolivian Government, says a recent commerce report, the President of Argentina has authorized the construction firm, Vezin & Co., to prolong northward, as far as the Argentine-Bolivian frontier, the line of the Central Northern Railway, and to place a bridge over the River La Quiaca. This work must be carried on under control of the general administration of national highways (of Argentina), which will place at the disposal of the constructing company all facilities possible to bring the work to a speedy and satisfactory conclusion.

Widening of Gauge on Curves

By ROGER ATKINSON

Analysis of Behavior of Rolling Stock on Curved Track of Tight Gauge

In any discussion of this subject there is little progress to be made by simple statements of what the practice may be by any particular road, unless some conditions are stated as to the reasons why such practice is adopted, giving wheel bases of rolling stock, both for passenger and freight service, and for freight cars and passenger cars, four or six wheel trucks, also for locomotives in each kind of service, giving number of pairs connected and whether flanged tires are used on all wheels or only on front and back, or other pairs.

So far as the writer's experience goes, after many years of riding on locomotives and coaches, there can be no doubt that side swing on coaches is a very definite source of trouble from bad riding, and in fact, some special instances of such trouble were promptly cured by reducing the lateral play on the axles. In the same way, with freight cars, some heavily loaded coal cars were watched carefully on curves, and showed plainly an enormous increase of resistance to curving when the side bearings came into play, and the flanges of the wheels ground very hard in compelling the trucks to come round to the curve. In one particular instance where the traffic of a yard was seriously delayed by the inability of the power to make the necessary movements in the time at disposal, an inquiry was arranged between the officers of the different departments, and it was shown that the power could not make the time, but on investigation, the track which was a reverse curve had been widened to enable the locomotives to get around, to such an extent that the freight car trucks skewed until the flanges of the wheels were cutting the rail heads, and slivers of the rail were picked up which were hot and had been just produced in that way. When the tracks were closed in to gauge and a suitable locomotive put on the service, there was no further trouble, and one engine did the work satisfactorily which two were unable to perform before.

On another occasion, trouble was reported in main line service, that the rail heads on curves were being cut away on the outer rail, and the cause was attributed to the length of wheel base on the locomotive, but after watching carefully for some time it was found that the wheels on four wheel trucks were showing cut flanges, and in one instance the flange was found to be exactly one-half the original thickness. The curves on this division were, as far as the writer's memory serves, widened about $\frac{1}{8}$ in. per two degrees of curvature with a limit of curvature of about 4 ft. $9\frac{1}{4}$ ins.

If, therefore, we discuss the question from the standpoint of "Why should the gauge be widened," we may certainly decide at once that no four-wheel truck requires any widening of gauge for any curve that is operated in main line service, and further, that any widening done for other reasons is very detrimental to the haulage of freight trains, entailing as it does, not only increased wear and tear of rails, wheels and trucks, but also increases the horsepower to be developed by the locomotive.

The next point to notice is that six wheel trucks, being longer in the wheel base, do not assume so much angularity for a given amount of increase in width of gauge, and therefore are less affected by it. On the other hand, the center pair of wheels require to move over to suit the curve, but if we take a truck with say 13 ft. wheel base, we find that on a 10 deg. curve, the center ordinate or versed sine is less than half an inch, so as there is plenty of play in the journals it does not affect the trucks at all. Consequently, so far as cars and coaches are concerned, it is a mistake to widen the gauge at all up to 10 degs., and, indeed, it would be beneficial not to do so.

This brings up the gist of the question. If a curve is to be widened it must be because it is deemed desirable or necessary to suit the locomotive. As it is obvious that a straight locomotive cannot be put on a curved track, some compromise or adaptation is compulsory. During the past fifteen years, or thereabouts, there has been a practice very largely adopted of flanging all driving wheels, apparently originally having been evolved out of an idea of having increased safety in the minds of those responsible. At the same time there has been an enormous increase in the size and weight and wheelbase of the locomotives used, especially in freight service. Driving tires have been set in on the front and back pairs of drivers to conform in some very slight degree to the curvature of the outer rail, and decrease the pressure of the middle set or sets of wheels against the inner rail, which is all right as far as it goes, and which is very little, as a wheel base of 16 ft., which is common, requires an offset of 11/16 ins. to fit the curve, consequently the difference, or about $\frac{1}{2}$ in. has to be very largely obtained by the bending of the rail heads out to suit. The argument to meet this is that $\frac{3}{4}$ in. play is allowed between the flanges of the driving wheels and rail heads, that is $\frac{3}{8}$ in. on each side. If a pair of tire templets are fixed on a bar in the correct position and placed on a pair of rails correctly set, it will show that the side play is largely taken up by the curve at the root of the flanges and this view is borne out by the fact that the wear at that point in service is extremely heavy. To confirm this it is only necessary to say that the writer has seen new engines only four months in service, which required to be taken into shop to have tires turned down $\frac{1}{4}$ in. in order to get good flanges again. Now, if this destruction takes place on the driving tires, which are not less hard than the rails, there has been as much or more destruction of rail heads from this cause alone. There is no information to show what the widening on curves was on the road where this took place, but from the writer's knowledge there was no reason to doubt that the common practice of widening was in service.

There has been considerable discussion in the last few years about broken rails, and enormous damage has been caused by wrecks from that cause. Of course, the increased size and weight of the locomotive has been met by the increased size and weight of rail, but would any engineer care to see the top chord of a bridge span deflected 15 or 20 degs. to one side while under the limit load calculated and considered safe when in a vertical position.

The logical conclusion is that only bald tires should be be used on the middle wheels of engines with more than two pairs of driving wheels, both in the interest of safety and economy. Atlantic Type locomotives have been operated for years with bald tires on the main wheels, as formerly were used on ten-wheeled engines, and up to speeds of 90 miles an hour were perfectly safe, showing no indication of the slightest undue wear on flanges, and no evidence of nosing at any speed, while nosing is quite observable with ten-wheel engines having all flanged tires and the front and back tires set in.

The wear of flanges, and of course, of rail heads has been largely diminished by the use of flange lubricators, but there can be no doubt that the movement of bending of the rail heads outward is facilitated by that lubrication.

The Chief Cause of Rail Creeping

By JOE RODMAN

Comparison of the Effects of the Causes and Remedies of Rail Creeping

Engineers ascribe the creeping of rail to various contributary causes, and though those cited have long been definitely established, there is yet considerable difference as to the relative importance of each.

Theoretically, it would seem that low joints and worn fixtures are the primary causes of rail creeping, and that opinion is very generally accepted. Mr. La Bach, in his excellent article in a late issue of Railway Engineering and Maintenance of Way, strongly supports this theory, though he minutizes more fully on the collateral influence of wave-motion, which he ranks as the secondary cause.

During the past few years several noticeable cases have fallen under the notice of the writer which tend to demonstrate that under ordinary conditions wave-motion alone is a stronger incentive to rail creeping than all other causes combined.

On coal-chutes, beet-dumps, etc., where the loads are pushed upward ahead of the locomotive, creeping is more noticeable than on level track where the traffic stress is more evenly regulated, and the creeping in such cases is invariably upward—or in the direction in which the loads are pushed—notwithstanding the counteractive influence of gravity, the "kick" of drivers, and the invariable descent under brakes, all of which are accepted as causes of rail creeping. Naturally, such structures are subject to less undulation than unsecured track, yet the surface variation is sufficient to cause a greater movement of steel, and in less time, than is usual on more normal track.

The locomotive being at the tail of the train, the kick or back stress of the drivers is insufficient to force the rail from under the weight of the advancing loads; though the returning empties and locomotive no doubt cause the steel to run slightly in the opposite direction, it is the difference in weight, and consequently wave-motion, rather than gravity or other causes from which steel is supposed to run.

As wrinkles are ironed from a cloth, increasing its length in the operation, or as mud "squashes" from beneath the forward tread of a wagon-wheel, so the track, retained immovably by the after weight, must advance in proportion to its resiliency and its length be increased by the depression of the advancing arch due to its elasticity. The greater the grade, the greater the arch to be depressed by the advancing load. That principle may also explain the frequent tendency of steel to climb a grade under apparently average conditions of traffic.

Many instances in busy yards will also tend to demonstrate that the greater amount of creeping is in the track on which the loads are more often pushed ahead of the locomotive. In larger yards this effect is the most noticeable owing to regular procedure of switching.

A landslide having demolished part of a coal-branch on a western road, a temporary switchback was built to replace the former spiral curve and the grade percentage slightly increased. On the grade approaching the switch, the loads were pushed ahead of the locomotive. During the three months of summer weather in which the switchback expedient was employed, the steel climbed the hill nearly three feet within less than one mile of track. At the spur end they impinged against a granite cliff and the last quarter of a mile was kinked so badly that the foreman in charge declared, "Sure, it looks like it wor built of gyar-r-rd rails."

There is little doubt that, notwithstanding the tension from the down-hill thrust of the reverse branch at the switchback—which crept downward—and the return locomotives and empty cars under brakes, the abnormal creeping was almost entirely due to the ironing out of the track before the advancing loads, or what is more commonly known as wave-motion.

Where the loads are pulled instead of pushed, the drivers pull an amount of the slack backward on the wave-motion, and, consequently, the creeping tendency is counteracted. Often on worn track or track with spikes and bolts loosened, it can be noticed that the joint will close slightly under the first driver. Careful measurements on such track will often show a decided creeping toward the advancing train instead of from it.

Though the impact against the rise following a low joint or other surface depression in track doubtless results in some of the "slack" being driven forward, and in the higher quarter being depressed and urged forward as in the ironing out of wave-motion, a careful comparison of track of good surface and one of poor surface, where the traffic is one way only on each, usually will show but a very slight difference between the forward movement of the two, while a track, level or inclined, where the loads are pushed ahead of the locomotive will show a great increase in creeping over the track subjected to merely normal or reverse traffic under the same conditions in other phases. Expanded joints, of course, conduce to creeping through impact though in lesser degree.

Rail anti-creepers are serviceable but expensive. In coarse rock-ballast the observant foreman can secure excellent results without the anti-creepers by seeing that all angle-bars are properly slot-spiked to good ties and that several ties ahead—in the direction of the creeping—are spaced with spawls selected to wedge the ties firmly apart, and so distribute and partly nullify the stress of any of the causes of rail-creeping, even the almost irresistable wave-motion.

On earth, sand, or gravel ballast, careful slot-spiking in the same manner and the use of one anti-creeper to the rail of 33 ft. or less in length will often reduce creeping to an almost imperceptible degree if several ties ahead of joint ties and creepered ties are spaced by sawed sections of old ties, bricks or stone paving-blocks immediately under the rail and concealed beneath the ballast. Where earth track is dressed lightly they may be placed far enough inside the rail to effectually conceal them if the ties are of sufficient strength to withstand the consequent shearing stress.

Another simple expedient is to smear with crude oil all angle-bars or continuous-joint plates as they are applied. The oil delays the rust-bonding and allows the rail more readily to expand and contract within its own length.

Often an experienced or well-instructed track-walker or laborer can alone accomplish much during the warmest weather by carefully searching out the tightest places, loosening the bolts in the more open joints, and tapping with a maul until the rail closes the open space. At times even a half-inch of expansion will prevent a serious "kick-out."

In spite of all precautions, rail will continue to creep until a change is made in the very nature of steel; but very simple precautions will go far toward reducing the movement. Paved track is almost immune, paving being a poor conductor of heat, and an open track, even under the most unfavorable conditions, it can be greatly checked unless the trackman in charge is himself subject to creeping.

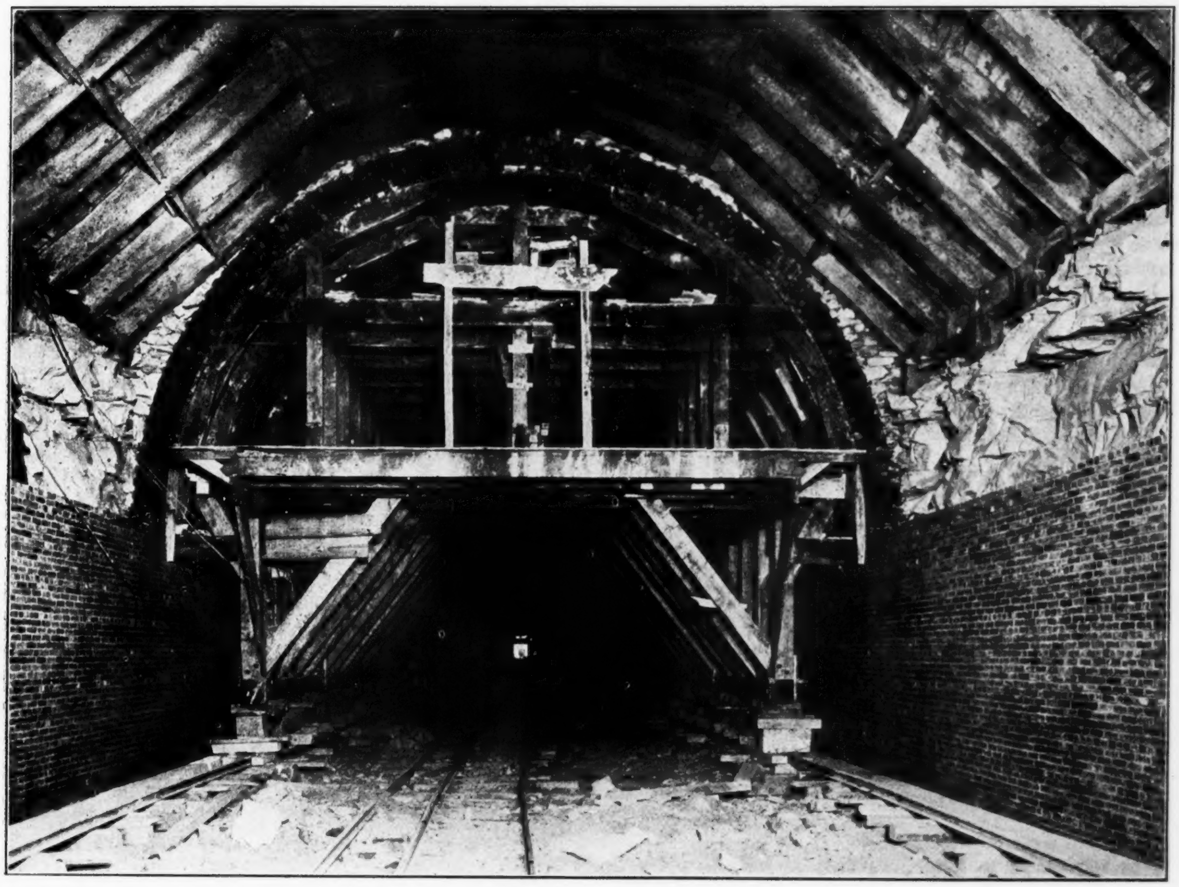
Nicholson Tunnel on the Deleware, Lackawanna & Western

Two shafts sunk; work carried on simultaneously at six points; rock at one end and soft earth at the other.

In making the change of line between Scranton and Binghamton the Delaware, Lackawanna & Western Railroad were compelled to drive a tunnel which is popularly known as the Nicholson tunnel between Clarks Summit and Hallstead. It is 3,630 ft. long. In it two vertical shafts were sunk. These were so placed as to divide the tunnel into three approximately equal parts. One shaft was placed one-third of the distance from the east portal and the other was located one-third of the distance from the west portal, thus dividing the tunnel into three. These two shafts, 34 x 54 ft. in horizontal section, were used for excavation purposes. They are lined with concrete and will remain as permanent ventilating shafts with a horizontal section 30 x 50 ft. The excavation of these shafts began September, 1912, and reached wall-plate grade as illustrated in one of our line cuts at a depth of about 115 ft. in April, 1913. Headings No. 1 shown in Fig. 2 were started in both directions from both shafts, with an average progress of 8 ft. per 10-hour shift. Heading No. 1 started from west portal cut September, 1913.

Where the roof would stand, without danger of falls, sections No. 2 (Fig. 2), were excavated close behind No. 1. Where the material was poor No. 2 was not excavated until the advance headings were joined and timbering was carried up immediately behind this excavation. When excavations Nos. 1 and 2 (Fig. 2) east from shaft No. 1 encountered earth, about 300 ft. from the east portal, work in this heading was temporarily discontinued. Section No. 3 (Fig. 2) was excavated just far enough ahead of No. 4 to permit the drilling of Nos. 4 and 3, and the material was thrown by hand into the shovel pit.

The west portal cut was excavated to grade in November, 1913, and a shovel started to excavate sections Nos. 3 and 4 (Fig. 2) at the west portal on November, 22, 1913. The shovel reached shaft No. 1 in July, 1914, and as the contractor was using steam locomotives it became necessary to provide air circulation between shaft No. 1 and some point near the east portal. In this the contractor, Mr. D. W. Flickwir, stated that his progress with steam locomotive was greater than could be obtained with electrical equipment.



Nicholson Tunnel on the Delaware, Lackawanna & Western Railroad, Showing Brick Walls and Arched Brick Roof

The east portal cut had been excavated to within 58 ft. of the grade at this time and an 8 x 10 ft. shaft was

sunk from this elevation at a point on the portal slope about 80 ft. west of the actual portal. A top center heading (No. 1, Fig. 3) was driven, and temporarily timbered, to meet the heading which had been discontinued, as described. This work was completed just

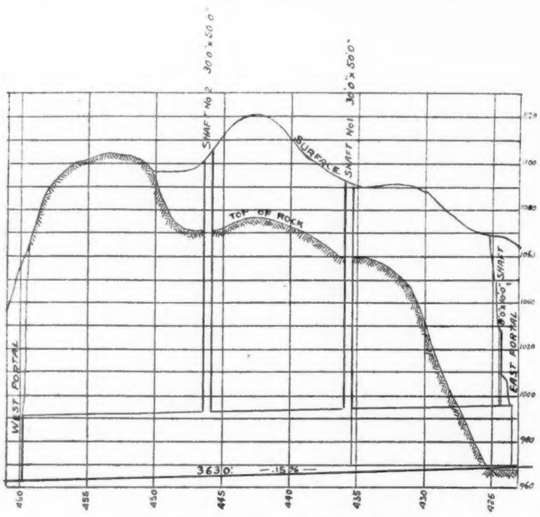


Fig. 1—Longitudinal Section

previous to the shovel reaching shaft No. 1. The 8 x 10 ft. shaft was then carried down to the spring line of the arch and the excavation of section No. 2 (Fig. 3) started and the wall-plate was put in place. This was followed immediately by the excavation of No. 3 and the placing of the timber. After this excavation and

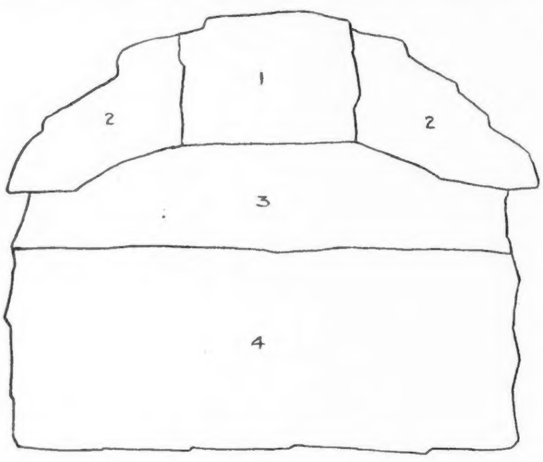


Fig. 2

timbering had joined the timbering already in place in the rock section the shaft was sunk to grade (Sec. No. 5, Fig. 3) excavated, and mud sills and plumb posts were placed. Section No. 6 was excavated by the shovel. This same process, with the exception of heading No. 1, was followed from the 8 x 10 ft. shaft east to the east portal. The shovel dug out at the east portal on November 7, 1914.

The rock encountered was blue and gray sandstone, horizontally stratafied. The strata varied in thickness from about 3 ft. down to a formation resembling shale, and these strata were frequently separated by mud seams up to ½ or ¾ of an inch in thickness. The earth was a dense yellow clay and gravel with some sand seams and were uniformly dry.

The entire tunnel was timbered, as shown in Fig. 4, and is lined with hard burned brick arch and side walls laid with a 1 to 2 portland cement mortar. The side walls rest on a concrete footing, and a concrete ditch and curb are provided. Complete details are shown in Fig. 4. Concrete footings were started July 27 and were completed December 6, 1914. The brick lining was started September 14, 1914, and was completed in May, 1915.

For constructing the brick arch the contractor provided three sets of movable centers, each 64 ft. long. Two of these centers were started midway between shaft No. 2 and the west portal and worked each way from this point. The other was started at shaft No. 2

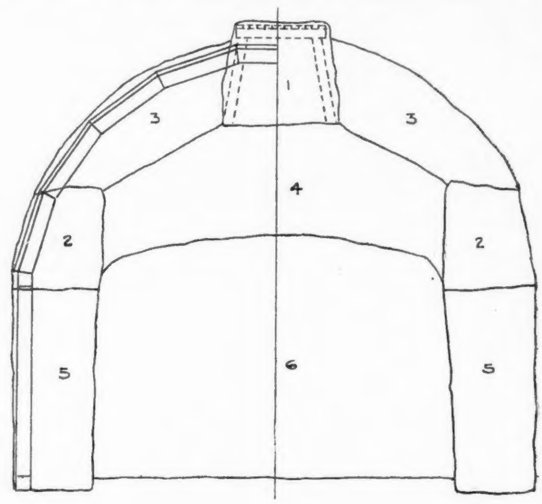


Fig 3

and worked toward shaft No. 1. When the portion between shaft No. 2 and the west portal was completed the centers between the shafts Nos. 1 and 2, and the set, which was at shaft No. 2, were moved to the midpoint between shaft No. 1 and the east portal and worked both ways from this point. The set at the west

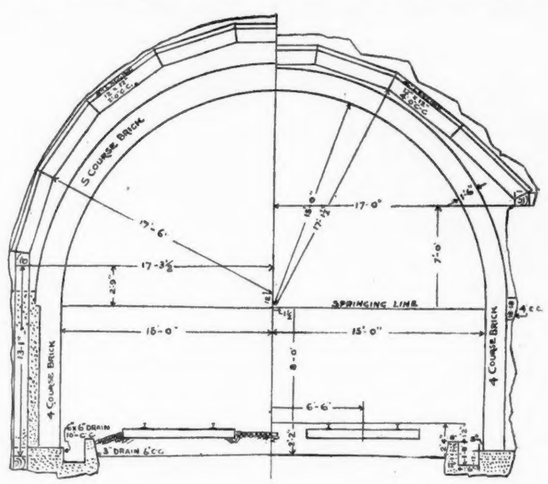
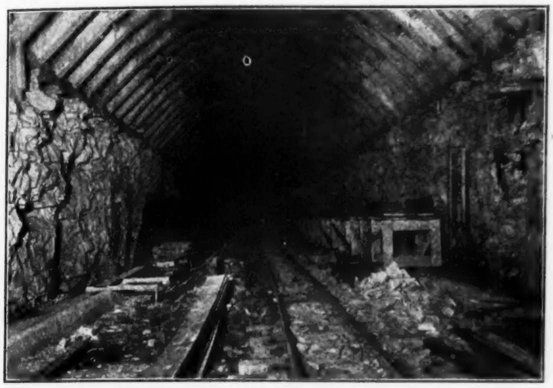


Fig. 4

portal was moved between shafts Nos. 1 and 2. The total tunnel excavation was 147,000 cubic yards.

Our half-tone illustrations show the west portal as it appeared in the course of construction. We also show the interior of the tunnel with roof timbered and sides of rock, the stratafication of the rock being clearly

visible. A temporary work track runs through the excavation. A view of the tunnel in course of construction gives an idea of the permanent brick lining of walls and roof, and shows the temporary support used in placing the brick arch. The whole of the work has



Tunnel, Showing Timbered Roof

been carried out, without drawback, to successful completion under the direct supervision of Mr. G. J. Ray, the chief engineer of the D. L. & W. Railroad.

The Size, Design, Quality and Service of Rais

The Importance of Investigation Along the Lines of Material and Structure of Rails

Speaking of rails at a recent meeting of the St. Louis Railway Club, Mr. E. A. Hadley, chief engineer of the Missouri Pacific, said in the latter part of his address, of which we here give a brief abstract, that the rails of the heavier sections of the A. S. C. E. design (from 80 lbs. a yard and up) have not in recent years given the service that was expected of them. The fault may be in improper methods of manufacture or it may be in the design of the rail itself, which, while suitable twenty years ago, may be unfited for the heavier loads of today. Three principal reasons have been advanced as to the probable cause of the poor service of these later rails:

It has been said that the wheel loads were exceeding the limits of strength of the steel in the rail, and without costly methods of manufacture, the rails could not be made to carry the loads with a proper degree of safety. Standard sections then in use were those of A. S. C. E. design. These were said by the manufacturers to be impossible to roll in the heavier weights then being demanded by the railroads. Railway engineers, while admitting that the rails would not stand the heavier wheel loads, claimed that the steel was of poorer quality than that used in the lighter rails previously turned out.

The making of steel rails for use under a high-speed passenger train service is something more than a mere commercial proposition, and both the producer and user have great responsibilities in the matter. Neither can lay them aside nor shift them one upon the other. Realizing the importance of the question, the American Railway Association appointed a Committee on Standard Rail and Wheel Sections to consider the subject. This committee, by a sub-committee on which the manufacturers were represented, presented a report October 1, 1907, which recommended the use of proposed standard rail sctions known as ARA Series A and Series B. The A type is characterized by a shallow head, wide base, thin flanges and a greater height than Series B. The 90-lb. type A rail is now used as standard by very many western roads, and the type B section is used on the coal roads in Maryland and Virginia, and seems to be preferred by the eastern roads, especially those with crooked track, probably on account of the greater amount of metal in the head to resist curve wear. At the present time both types appear to be giving good service.

The proper length of rail has received considerable attention and 33 ft. now seems to be the length most in favor. The use of much longer rails is limited by the difficulty of straightening at the mill, the cost of manufacture, the difficulties of transportation, expansion and contraction in track, and the labor and cost of handling.

The controversy over the most satisfactory rail joint has been going on for years, and there are now a number of very good patented rail joints on the market. The cheapest joint giving good service is the angle bar, and it has the advantage over most other joints in that it is easy to put in and can be applied without respacing the ties at the time of rail laying. Its strength, however, is computed as not over 70 per cent of the strength of the unbroken rail, whereas some of the patented joints have a strength of over 100 per cent of the unbroken rail. Careful tests of the angle bar and a number of patented joints applied to 85-lb. rail failed to develop sufficient economy of maintenance, all things being considered, to make it possible to say definitely that the angle bar was not the most economical joint. With light sections of rail the angle bar is decidedly inferior to a number of patented joints, but with the heavier weights of rail and the greater height from base to head of the rail with the angle bar made to suit, shows that it is efficient and satisfactory.

The present general practice for turnouts is to use the split switch and a spring-rail frog where the traffic over one line is much heavier than over the other line, and where speed is high on one and low on the other line. The stiff frog is generally used for yard tracks. Of late years the use of manganese steel for crossing frogs and switch points which are subjected to heavy traffic is coming largely into use and giving excellent results. It secures several times the life of the ordinary carbon steel frog and point at a reasonable increase in first cost.

Economy of train service has become so important that there will be no return to lighter loads. The tendency is and will continue to be in the direction of heavier loads. The track is, as a matter of fact, a continuous girder, connecting the terminals of a railroad, over which pass the same loads, at the same speed, as pass over the bridges. The importance, therefore, of giving to the design and construction of the track the same careful investigation and study which are considered necessary in the design and construction of a bridge, cannot be overestimated.

Spiking Tie-Plates to Rails

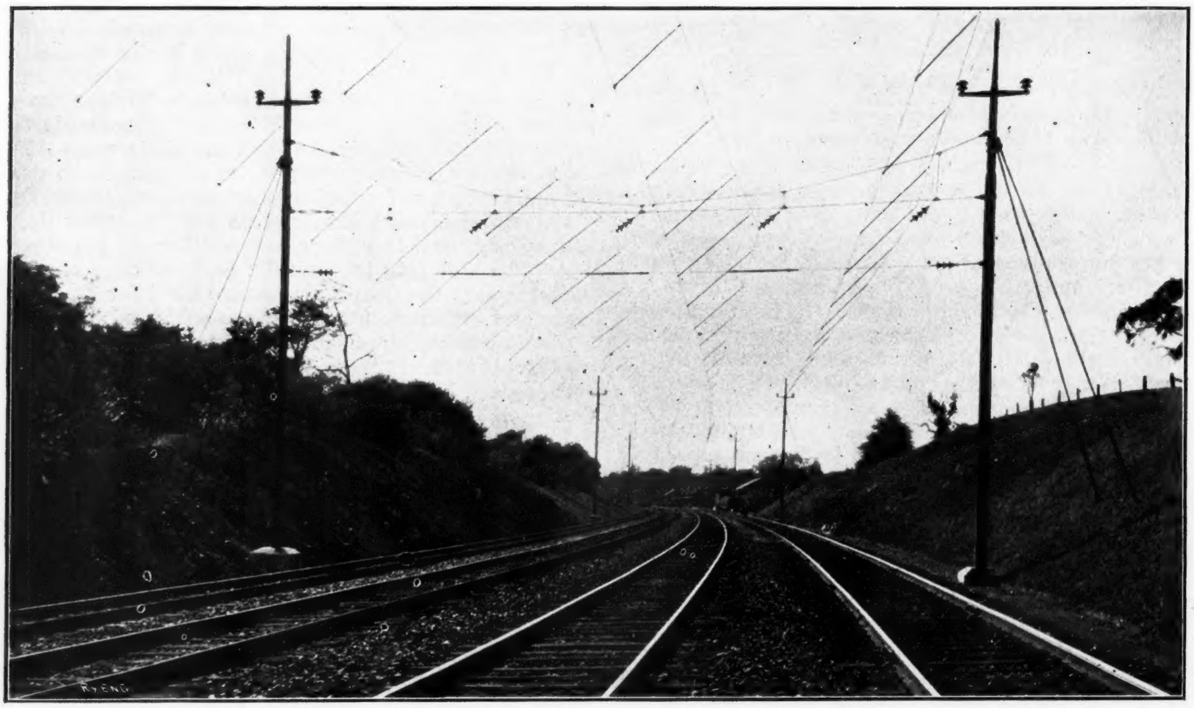
When discussing the matter of track construction at a meeting of the St. Louis Railway Club, Mr. H. J. Pfeifer, Eng. M. of W. T. R. R. A. of St. Louis, Mo., said that the track question is of the greatest importance to the railroads, and also to the street railways. Referring to the question of screw spikes he held that the ordinary cut spike which is in use today is, under present conditions, more economical, and holds the rail just as well as the screw spike would. With reference to saving the tie, it was his opinion better to lengthen the tie-plate, place hooked shoulders on it to hold the rail, and then spike the tie-plate to the tie without having the spike engage the rail. This does away with a great deal of the cutting of ties, resulting from heavy traffic, and materially increases the life of the tie.

Electrification on the Pennsylvania Railroad

Current Received at 13,200 Volts, Transmitted at 44,000 Volts, Stepped Down to 11,000 Volts, Single Phase For Catenary System.

The electrification of the suburban service of the Pennsylvania Railroad between Broad Street Station and Paoli is the first electrification undertaken by this company in the vicinity of Philadelphia, and its primary purpose is to increase the capacity of Broad Street Station and thus to relieve what congestion it can at that terminal. In addition to the through passenger train service accommodated at the station, there is an extensive suburban service extending over six different routes. The possibilities of electric traction were examined into by committees consisting of operating officials of the road and their analysis indicated that during rush hours the relief which would be secured by electrification would be equivalent to greatly increasing the station capacity. It is estimated that under electric operation there is a sufficient saving in operating costs as compared with steam to pay interest on the investment. Analysis of service conditions and cost estimates covering various electric systems led to the conclusion that one having a very high voltage overhead contact wire and one which eliminates moving machinery in substations for the supply of power, is the most suitable and also the most economical from the standpoint of both first and operating costs. In arriving at this conclusion, primary importance was attached to the feature of possible long distance operation over the entire divisions rather than to the requirements for present short suburban electric service. In this case 11,000 volt, single-phase 25-cycle power is supplied directly to the trains from the overhead catenary trolley system.

Power for traction purposes is purchased from the Philadelphia Electric Co. It is delivered to the railroad at a substation on the westerly bank of the Schuylkill River opposite the main generating station, the connection between the power house and the substation consists of armored submarine cables under the river. It is delivered at 13,200 volts, and is stepped up to 44,000 volts and, by means of duplicate single-phase overhead transmission circuits, then transmitted to the stepdown substation. While the present service is on one phase only of the power company's three-phase generating system, the plan is to supply the succeeding or future electrification power requirements from the remaining phases. Power at 25 cycles and 13,200 volts is transmitted from the electric power house to the Arsenal Bridge substation over four 350,000 c.m., 3-conductor submarine cables. On the west bank of the river the submarine cables are connected to paper-insulated, lead-covered cables, installed in clay ducts. From the Arsenal Bridge substation there are four 44,000-volt single-phase transmission lines to the West Philadelphia substation. The four transmission lines are carried on brackets on the side of the elevated structure between the Arsenal Bridge substation and the West Philadelphia substation. Beyond the West Philadelphia substation the lines are carried on the catenary supporting structures. Along the right-of-way the lines are carried on both sides of the tracks. Horn gap switches for sectionalizing are installed on the roofs of the three substations and lightning arresters on the roofs of all substations.



View of Pennsylvania Railroad, Showing Catenary Suspension System as Applied to Curves

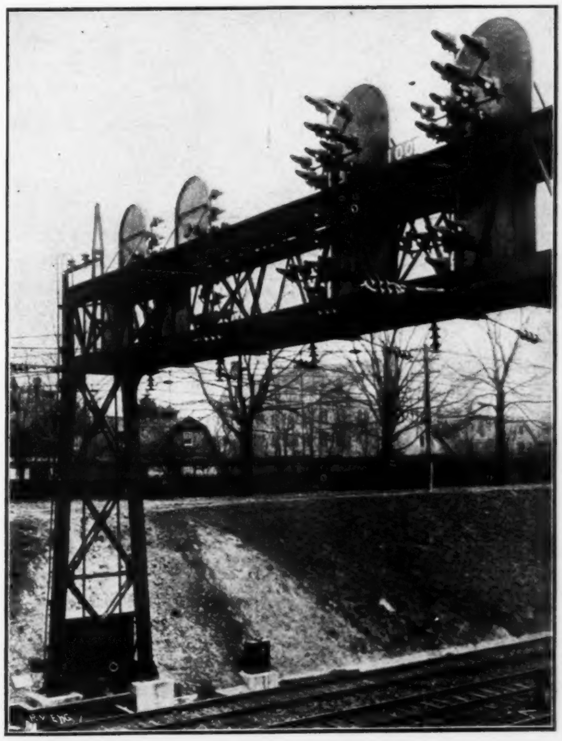
The transmission lines are 2/0-7 strand, hard-drawn copper wires. Wires are spaced 5 ft. apart where the two wires of a single-phase feeder are on the same

cross arm and where there is more than one circuit on a pole the vertical spacing is 3 ft. 6 ins. The lines are protected by a $\frac{3}{8}$-in. steel ground wire on the top of the poles. Where the transmission lines pass under highway bridges, the ground wire is dead-ended on the bridge structure and the wires carried on post type insulators. At the Arsenal Bridge substation the lines are protected by relays which operate on overload and on an unbalanced load in either leg caused by a ground. In the other substations the relays operate differentially only, and in case of a ground between substations the circuit on which the trouble occurred would be cut out first in three of the substations and finally at the Arsenal Bridge substation. Overload relays are provided in the 13,200 volt lines at the Philadelphia company's power station and reverse current relays in these feeders in the Arsenal Bridge Substation. After erection the transmission lines were tested out at a potential of 66,000 volts, or three times the working pressure, to ground.

In order to try the various types of structures and details, an experimental four-track section about a mile long was completely equipped in the fall of 1913. An examination and study of this led to the adoption of what is called the "tubular cross-catenary bridge" for carrying the catenary trolley wires. On either side of the tracks a tubular steel pole is set and grouted into a concrete foundation. Each pole has a double guy, anchoring the pole away from the tracks and spanning the tracks between the poles are the two cross wires forming the cross catenary bridge which carries the longitudinal wires. The tubular poles are built up of various lengths, sizes and weights of steel pipe welded together as required. The guys are solid steel rods with a heavy turnbuckle near the ground end to permit of adjustment. The cross wires are of extra high tension galvanized steel strand, the upper strand usually being $\frac{3}{4}$ in. and the lower one $\frac{1}{2}$ in. in diameter. Both are socketed at each end and at one side a turnbuckle is installed to permit of adjustment. The top and bottom cross wires are joined by means of a vertical $\frac{3}{4}$ in. rod and suitable malleable iron clamps at the points where insulators carrying the longitudinal wires are placed. Each insulator consists of three suspension type units, the porcelain being 8 ins. in diameter, the flashover value of the three being many times that of the line voltage. The cross wire bridges are about 300 ft. apart on tangents, but are closer on curves, the exact spacing depending upon the degree of curvature. After the bridges are erected, insulators are suspended approximately over the center of each track; they are over the center of the track on tangents, but are offset towards the outside of the curve on curved track. Every 15 ft. on curved track and 30 ft. on tangents, a hanger supports the lower two wires from the "messenger" wire.

On the Terminal Division, where the steam locomotive traffic is very dense, and there are smoke and corrosive gases, a non-corrodible tube hanger is used. The hanger tube, which is 9/16 in. outside diameter and No. 18 gauge, being fastened to a casting at each end. Some of the tube is Monel metal, while the balance is a bronze mixture containing 90 per cent copper. On the Philadelphia Division, where there is relatively less steam traffic, wrought iron strap hangers 1 in. wide by 3/16 in. thick are used. The main messenger cable, at the hanger clip, is protected from corrosion by a collar of zinc. The flat strap hangers which have a quarter turn in them to minimize the area exposed to the wind in the direction crosswise with the tracks and to better resist bending when placed on curves, are bolted to the castings clamping the auxiliary messenger and trolley wires. On tangents, the castings at the bottom of the hangers hold the auxiliary messenger only and the trolley wire is, in turn, supported from this auxiliary messenger every 15 ft. at points equidistant from the hanger. This is intended to insure a flexible trolley wire. On curves the two lower wires do not hang directly beneath the messenger, but the whole system swings into a curved plane until a balance is reached between its weight and the tension in the wires. The tensions in both the auxiliary, messenger, and trolley wires, are selected so that in extreme hot weather there will be enough tension to prevent sagging and yet in extreme cold weather the contraction will not cause stresses beyond the elastic limit.

The catenary system over each of the four main tracks is separated electrically from those over the other tracks, and trolley sectionalizing points with switches are provided at all crossovers, so that sections of the line may be temporarily cut out of service for repairs.



Close View of P. R. R. Signal Bridge

On the main running tracks sectionalizing is of the "air-break" type, the trolley wire being divided into two wires which are spread apart and each wire is lifted up at a different point; insulators are placed in each wire where it hangs above contact with the pantagraph—that is, while the pantagraph is making contact with one wire the other is lifted up and sectionalized. At crossovers and in yards, the trolley wires are sectionalized by means of wood stick insulators, having runners or gliders on each side so arranged that while the pantagraph always makes contact with at least one of the runners they are separated electriclly. The switches are of the disconnecting knife type, mounted on top of the wood section insulators, and are operated from the ground by means of a long, impregnated wooden switch stick. An interesting detail in the erection of this catenary work was the use of cars the top platforms of which could be readily raised or lowered by means of chain hoists. The cars were equipped with removable outriggers so that in the four-track section

the work could be completely erected over one of a pair of tracks without in any way interfering with the regular steam traffic on this track.

The electrified route is crossed in many places by overhead highway bridges, some of which are not high enough above the tracks to permit the trolleys being carried at the normal height of 22 ft. In such cases and where it was impracticable to raise the highway bridge, the trolley wires gradually dip and go under the bridges at a less height than 22 ft. The catenary bridges are so located that these highway bridges come in the center of a span where, due to the sag in the messenger, the vertical height necessary to clear the catenary system is a minimum. As it passes under the highway bridges each catenary system is steadied by being held with post type insulators, supported by brackets on the bridge structure. The transmission wires on either side of the main line tracks are also carried down underneath the bridge and supported from the bridge structure by the insulators. At each bridge the metallic brackets carrying the insulators are carefully bonded together and earthed by means of ground plates. To prevent pedestrians on the bridges from contact or interference with the wires solid wooden fences, either vertical or inclined, and of sufficient height to shut out all view of the wires have been erected. In order to fully protect the trainmen, general orders have been issued that no men are allowed on top of any car in the electrified zone.

Typical Signal Bridge of P. R. R., Showing Position Signals for Day and Night

BURYING TIES IN EARTH

Editor Railway Engineering and Maintenance of Way:

Sir—In the brief but interesting account of the railways of Brazil in your issue of December, 1915, Mr. F. A. Molitor refers to the custom of burying the ties, of earth ballasted track, stating that there seemed to be no good reason for it, and that this method resulted in poor drainage.

In the Argentine, Uruguay and Paraguay, this custom is well nigh universal, particularly in those regions where the only material available for surfacing is the rich gumbo-like soil which is splendid for agriculture, but about the worst possible material for track. Unless the ties are completely covered and a hard unbroken shell-like surface formed, covering them entirely, the heavy rains work down alongside the ties to the soil on which they rest, they begin to "pump" and in a short time the track is gone.

There is a tendency to form a hollow or ditch between the rails where there is considerable pedestrian travel on the track as is the case in some instances, but it is more usual on well maintained track to keep the dirt slightly crowned between the rails, and drain the space by depressions under the rail at every fourth tie on alternate sides.

In covering the ties or "boxing in" the track as it is called, care is taken to get a smooth surface, which gradually gets baked hard and which if carefully put on and maintained, sheds the water and keeps it from getting under the ties. The principal object is not so much protection of the ties from decay as providing a means of surface drainage and of keeping the soil underneath dry. In the Argentine where ballast is available, or where material is used which will drain, the type of track construction is practically the same as our own.

F. CAIRS.

New York, N. Y.

Methods of Securing Track Maintenance Laborers

Arrangements adopted by a number of Roads for Securing Adequate Forces for Section and Construction Work and the Policies Involved

ON THE CINCINNATI, HAMILTON AND DAYTON

By F. D. Batchellor, Dist. Engineer M. of W.

Trackmen on C. H. and D. Ry. of the Toledo division are obtained from Cincinnati and Toledo with the exception of a few section men, who are obtained locally on outlying sections. In the Indianapolis and Wellston divisions section men are obtained locally. These men are not hired through company or private labor agencies, except extra gang men, who are sometimes obtained through labor agents at Cincinnati and Toledo. We do not have an employee at private labor agencies, nor have we any labor bureau, as we have not had much trouble in getting men.

As far as possible we try to keep trackmen permanently employed, although it is necessary in winter months to reduce the force. Where other than natives are employed we build shelters for them to live in, old box cars usually being used for this, cars being set off trucks. The men board themselves. We have no special inducement to offer men to stay in our employ other than chances for promotion. Men are always promoted from the ranks if they are capable.

We have found that we have obtained good results by having an extra gang of about fifteen men in charge of an assistant foreman, who is moved from section to section where there is work to do, the assistant foreman reporting to and working under the direction of section foreman. This enables us to get much better work out of extra gangs than we do in cases of where gangs are placed in charge of extra gang foreman, and this plan also reduces the cost of doing the work, as the section foreman takes more interest in work done on his section than an extra gang foreman does.

In placing gravel ballast, instead of having extra gang in charge of this work, we have increased our section gangs and find much better results are obtained and track put in much better shape than could be done by extra gangs.

Another method we have tried which has resulted in the saving of labor and reducing the cost of work is in the rail laying gang. In this we have a three-man track laying machine, which enables us to dispense with nine men in handling rails, and also does away with the danger of injury to the men in handling rails in the old way. We have found that rail can be laid in this manner much more economically and quickly than by the old method.

We have a number of cases where our tracks pass through towns where the ballast has become in bad condition and where we are not able to raise our tracks, thus making it necessary that the old material be dug out from tracks and new material placed under the ties. In this case we have used the American ditcher with a clam shell, digging out material between tracks and loading it on cars and then shovel out by hand the material from between the ties and filling up holes dug out between tracks, new gravel then being distributed. This is handled by a small force and as a result there is considerable saving in labor and work train service.

We have run over our territory a McCann spreader, which has a wing the shape of the roadbed. This machine has been run from one end of our road to the other and has dressed up all of the ballast and shaped the roadbed. In order to get rid of the shoulders which are thrown up by the first wing, a second spreader is also run behind the first. This has enabled us to maintain our track a great deal cheaper than we could have done otherwise, as it has helped drainage conditions materially.

There was an old abandoned gravel pit at North Dayton, out of which gravel had been taken to the water level. As we were badly in need of gravel and had no other pit available, we placed a whirley with a clam shell in this pit, getting out gravel below the water level. This has given us a good supply of washed gravel very economically as it is not necessary to have a spotting engine to spot cars.

ON THE MICHIGAN CENTRAL

By J. J. Bernet, V. P. in Charge of Operation

The majority of our laborers for extra gangs doing work of rail laying, ballasting, spacing ties and construction work are obtained through private labor agencies in the cities of Hamilton, Ontario; Detroit, Michigan; Chicago, Illinois, and Toledo, Ohio. Laborers for regular sections, yards or small permanent extra gangs are usually hired in the towns or villages nearest the points where they are to be worked. This company has no company labor agency, and no representative at the agency to accept them.

An attempt is made to keep track laborers on regular sections, yards or small permanent extra gangs continually employed, though it is often necessary to reduce these forces during the winter season. Endeavor is also made to give extra gangs as much work as possible during the winter months by allowing them to remain in living cars and use them whenever occasion demands to clean up snow and ice and to pack ice during the ice harvesting season.

Cars containing berths, stoves, lamps and fuel are furnished foreign laborers. Extra gangs are housed in trains operated by a contract boarding concern which insures the men good sleeping and boarding accommodations at reasonable rates. Laborers for sections, yards and permanent extra gangs are usually recruited and worked in the territory in which they live, and provide their own living quarters and board.

The laborer in each section gang showing most promise is made first man and he relieves the foreman in case of sickness or absence for other causes, and the first man most eligible to assume a foreman's duties is appointed section foreman when vacancy in such position occurs.

ON THE CHICAGO, BURLINGTON AND QUINCY

By H. E. Byram, Vice-President

We obtain the greater number of our laborers from Chicago, St. Louis, Kansas City and Omaha, through either private or company labor agencies. There are several company agencies but no labor bureau.

It is found necessary to reduce the force in the winter and therefore impossible to keep all the section men permanently employed.

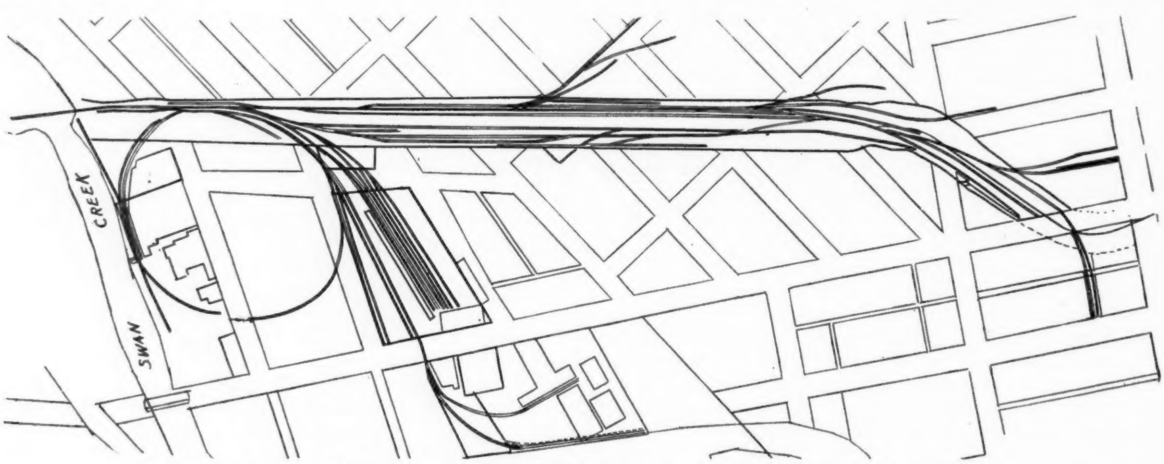
Each section is furnished a house in which section laborers can live. Extra gangs are furnished with bunk cars and commissary, except foreigners, who provide their own commissary.

Freight Terminal on the Clover Leaf

Valuable Property Acquired and Constructive Management Have Made this Terminal Successful

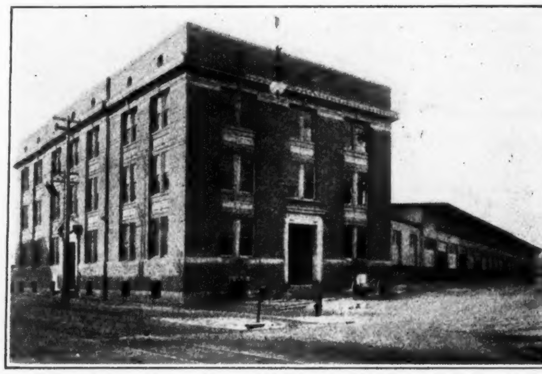
After its reorganization in 1900 the Toledo, St. Louis and Western—known the country over as the "Clover Leaf"—needed, among other facilities, suitable freight terminal yards at Toledo. This road is one of the Central West important lines, which, starting as a "pirate" many years ago, has developed into a property which has to be reckoned with in these days by all the lines in that territory. Oftentimes the criminal is set on his feet after years of probation and becomes a citizen of the highest respectability. The Clover Leaf stands in that position today, even though it is operated under a receiver, whose control was ushered in by most unfortunate financial operations, for which the road as a once successful enterprise was in no way to blame. Unwise and unnecessary acquirements were the cause of its downfall.

Enthusiastic and money-chasing fiscal agents, encouraged by a few individuals in power, are as a rule to blame nowadays for the misfortunes of many a railroad property, which, if unhampered, would reward those interested in its securities handsomely. The 451 miles of road between Toledo and St. Louis runs through a most productive and interesting country. Added to this is the Detroit & Toledo Shore Line, owned jointly by the Grand Trunk and the "Clover Leaf," which gives the latter road an excellent Detroit entrance and furnishes a large amount of both East and West bound traffic. For a dozen years after its reorganization the "Clover Leaf" enjoyed unusual prosperity and was on the high road toward permanent dividends and an absolutely sound financial standing, when its misfortunes began under unwise handling.



Layout of Tracks and Property owned in Toledo, O., by the Toledo, St. Louis & Western

Some day, like other properties under similar conditions, it will come forth from its unwarranted financial disturbances and resume its course as an institution of the first class. In the past fifteen years it has never lost its reputation for respectability at all events and serves the country through which it runs well. The property known as the "Erie St. purchase," in Toledo, was acquired in parcels, from time to time, without a beating of drums or a blowing of horns, in 1902 and 1903, and that, with other acquisitions and rights, now furnishes the company with the best terminal facilities of any road running into Toledo today. It provides a close touch with many important industries, and in connection with the Toledo Railway and Terminal Co., of which the "Clover Leaf" is a part owner, it furnishes direct service to and from every industry in this, at present, rapidly growing community. The general office building, which occupies an important corner at Erie and Krause Sts., is immediately connected with the commodious freight house, which is most necessary for prompt transaction of business between the local freight



Freight Terminal on the Clover Leaf at Toledo

agent and his assistants and the officers at the head of the traffic department.

The arrangement of the tracks in the freight yard is most convenient, as shown by the accompanying drawing, while the approach to industries provides ample facilities. The whole system of tracks and yards is directly connected with the main line, so that incoming and outgoing trains are handled to the best advantage. This property, which was "picked up" piece-meal at figures absurdly low, could not be secured today except at a fabulous price. It is an example of forethought worthy of imitation by many roads which as a rule are generally short of facilities which eventually they have to provide at tremendous cost.

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You want to be a popular, progressive, successful man. You perhaps feel that you have done everything in your power to that end. You have worked early and late with but small or medium returns, and have seen others make a brilliant record with seemingly little effort. Do you think it is "luck"? They have simply discovered their possibilities. You can very likely outstrip them when you find yourself.—Geo. H. Knox.

A Study of Electricity

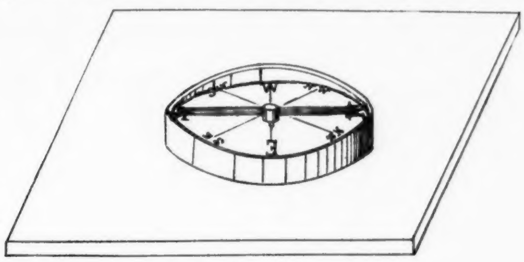
By REGINALD GORDON

Magnetic Effects of Electricity Explained and Simple Experiments Suggested

Under this title in a previous issue an outline was given of the uses and applications of electricity in railroad service. The following table gives the uses to which railroads put the silent power

RAILROADS USE ELECTRICITY FOR	POWER	Locomotives Motor Cars Shop Machinery Turn Tables and Drawbridges Telegraph Circuits Signals
	LIGHT	Locomotive Headlights Car Lights Signal Lights
	HEAT	Shop Work—Welding Heating of Motor Car Trains
	CHEMICAL ACTION	Charging Storage Batteries for Car Lights, Signal Motors, etc.

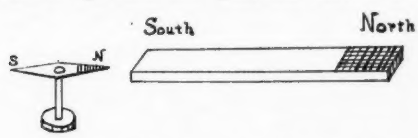
Electricity may be generated or developed in several ways, but only two of these methods are of interest to



The Mariners' Compass.

railroad men, these are batteries and power-driven generators. Batteries depend upon chemical affinity or attraction for their action and are used for a variety of purposes on railroads. Power-driven generators are of two principal classes—magneto-electric and dynamo-electric generators.

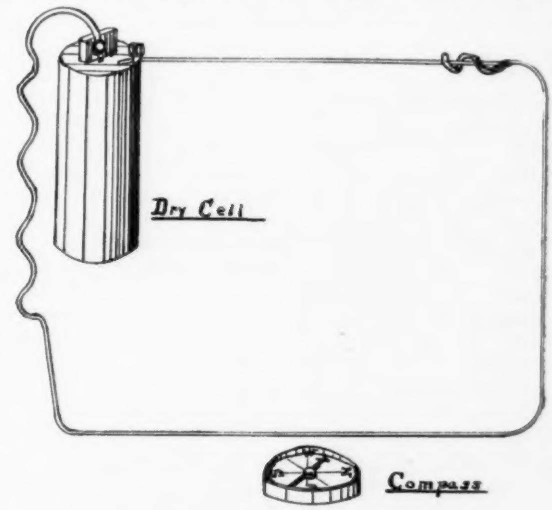
Magneto-electric machines are used for furnishing electric ignition for gasoline-driven automobiles and



North and South Poles of Magnet.

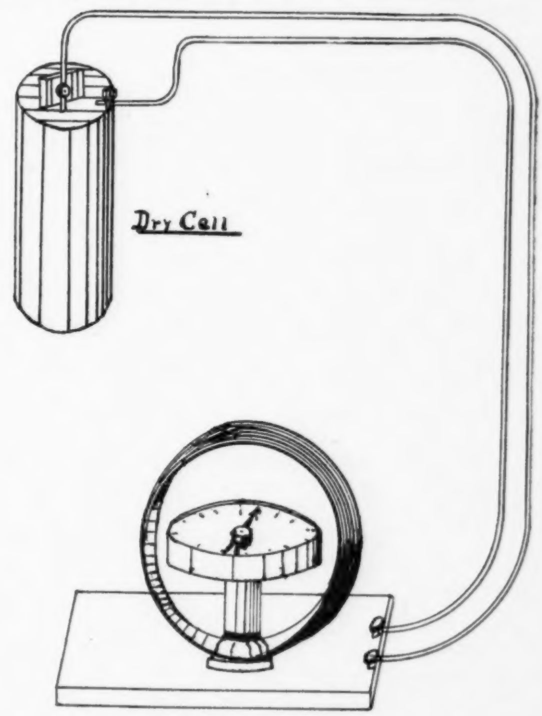
railroad motor cars, as well as for the ringing current on some telephone systems. Dynamo-electric generators are used for all large power, lighting and chemical purposes, such as power for operating railroad locomotives and cars, for furnishing light and heat for stations and cars, and power for operating signals, as well as for charging storage batteries.

Electricity and magnetism are terms commonly used in connection with each other, which while expressing two closely related ideas are not always interchangeable. Many persons are familiar with the use of the magnetic compass shown in Fig. 1 for indicating direction, and most of those who have used it have learned that its behavior is dependent upon the magnetism of the earth. The "needle" of the compass is a straight piece of magnetized steel supported so that it can swing freely in a horizontal plane. It comes to rest with its longest axis in the north and south line because the earth itself is a magnet and by its unseen force exerts a steady pull that causes any magnets that are free to move to arrange themselves in a particular direction in any particular place. The relation between electricity and magnetism can be shown by many experiments. One of the simplest, and one that can be made with simple apparatus is shown in Fig. 2, where a single battery cell, com-



Electric Action Shown by Compass.

monly known as a dry cell, such as is used for electric bells, spark coils, etc., is shown with a piece of wire attached to its terminals. When this wire is held near the compass in the position shown the magnetic needle

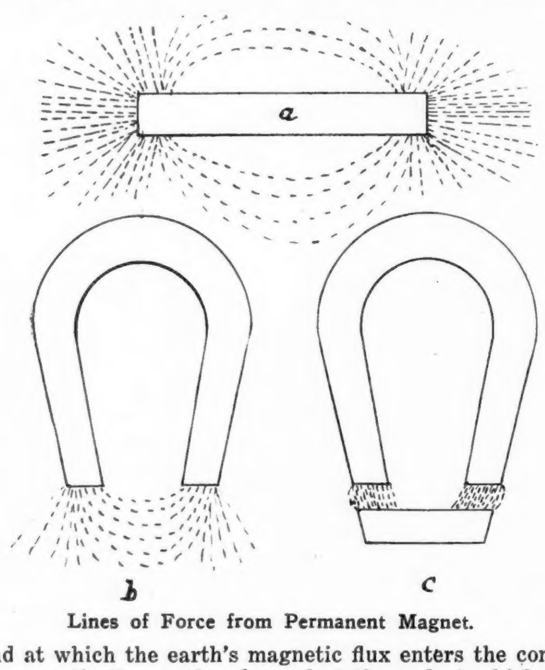


Electric Action Exemplified by Coil and Compass.

turns away from its north and south position because the electric current in the conducting wire produces magnetism around it, and this magnetism being stronger than that of the earth, pulls the needle away from its natural position. By winding this wire into a compact coil of many turns, as shown in Fig. 3, its effect on the

needle is greatly intensified. The effect of the current upon the magnet is approximately proportioned to the number of turns of the conductor forming the coil. The current develops a magnetic effect around it that influences the needle and produces the observed effects. The space around a magnet or conductor conveying electricity and throughout which its influence is exerted is called its "field." Whenever a magnet, or a magnetic substance, such as a piece of iron or steel, is brought into this field it is influenced by it. If the magnetic substance can move freely it will assume some position in the field where it offers the least resistance to the flow of the magnetic lines through it. Fig. 4 illustrates this principle and shows that there is attraction between unlike named, and repulsion between like-named, magnetic poles.

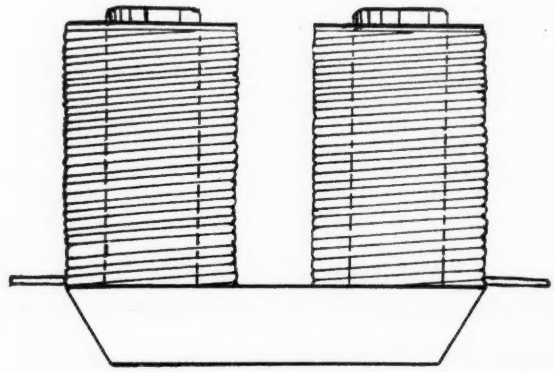
In order to render this clear there are shown in Fig. 5 three cases illustrating the condition of the space around or near a magnet. These show the position assumed by fine iron filings that have been scattered on a piece of cardboard placed on top of a bar magnet and a horseshoe-shaped magnet, respectively. The experimenter will find that when the iron filings are sprinkled evenly on the cardboard and the latter is gently tapped, they will arrange themselves end to end in certain distinct lines. Each particle of iron becomes a magnet and is forced to assume a position where it offers the least resistance to magnetic force. The lines in which the small pieces of iron arrange themselves are called lines of force or lines of magnetic flux. While we do not know with any certainty what magnetic force is, it is usual to regard it as a form of energy which is always flowing in a closed circuit and in a definite direction. The direction of this flux or flow in the compass needle is through it from one end to the other, and we call the



Lines of Force from Permanent Magnet.

end at which the earth's magnetic flux enters the compass needle the south pole, and at the end at which it leaves, the north pole. This is only a conventional designation, just as are the names north and south, as applied to those regions of the earth at which its magnetic force seems to be concentrated and to have its origin.

For the purposes shown in Figs. 1-5, permanent magnets are used, made of hard steel, a metal rather difficult to magnetize to any great degree of strength, but having the advantage, when once magnetized, of retaining its magnetic strength for a long time. Wrought iron is very much more susceptible to magnetism than cast iron or steel. Certain grades of soft steel containing a low percentage of carbon are equally susceptible with wrought iron; and in general throughout the range of iron and steel of various degrees of hardness, the harder the metal the more difficult it is to magnetize it, but the better it retains its magnetism. It may be stated, however, that the magnetic properties of any grade of iron or steel depend largely upon the chemical



Coils About Soft Iron Cone of Electro-Magnet.

composition of the iron. For this reason most electromagnetic devices, such as generators, motors, etc., are made with electro-magnet cores of soft iron or mild steel, because a given amount of electricity in the conductor wound around the core produces the maximum amount of magnetism in it. Furthermore, up to what is called the limit of saturation, or all that it will take without any escaping, the amount of magnetism that can be produced in a given piece of iron or steel depends on the amount of electricity that can be sent around it through the windings of the conductor. Thus it may be seen that while "permanent" magnets are quite limited in their power, electro-magnets made of iron and coils of insulated copper wire can be made of any capacity desired.

The limit of magnetic strength with permanent steel magnets is soon reached. All large magnets are made by winding an iron core with many turns of insulated wire, as shown in the diagram Fig. 6. As intimated in the last paragraph the capacity of these depends upon the size of the core and the amount of electricity that can be forced through the coil surrounding it. As any one who has worked with large electro-magnets is aware, the field of a magnet of this kind can be made so strong as to pull large pieces of iron from the grasp of a person holding them in front of it. Another instance of the same power is that made use of in lifting magnets which are employed on cranes used for handling large masses of iron and steel.

In order to understand more clearly the action of an electric generator or motor a few experiments with simple apparatus will be described later. It may be stated in advance that generators and motors consist essentially of two parts, a fixed part and a movable part. These are often referred to as the stator and the rotor.

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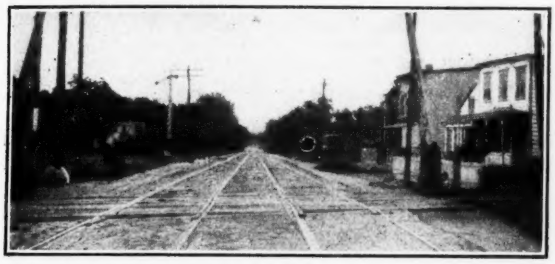
The Southern Pacific is planning to build two large freight steamships to be used in coastwise traffic between New York and the Gulf of Mexico. At present this company is using in this service eight extra steamships chartered from other lines.

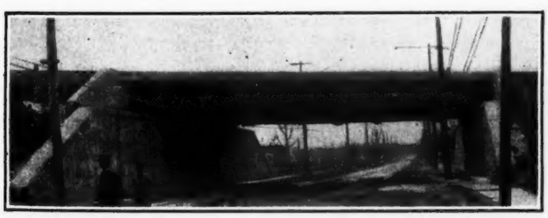
Methods and Value of Grade Separation at Crossings

Valuable Light on the Cost of Eliminating Grade Crossings; and on the Cost of Maintaining "Protected" Crossings.

In the early days of railroading, when all railroads intersected the public highways at grade, the legal talent of the common carriers deemed that responsibility for accidents ended when a large sign was extended across the highways at such points, announcing plainly: "Look out for the engine while the bell rings!" All that the railroad company had to do then was to provide bells for the locomotives and direct the engineers to ring their bells on approaching and going by these crossings. If the bell did not ring at the proper time, the company, in case of an accident, was liable; otherwise the foot passenger or driver of a vehicle shouldered the blame and could not recover for his inadvertence. This may, in a measure, be the substance of the law today, but railroad companies are required to do more than this, on occasion, depending upon location and conditions generally. The freedom with which real estate syndicates have laid out streets and thoroughfares across the railroads in growing sections has added further menace to the situation, with no chance, as a rule, for successful opposition, on the part of the railroad companies, to the danger.



Rockaway Avenue Crossing Before Grade Separation, L. I. R. R.



Rockaway Avenue Crossing After Grade Separation, L. I. R. R.

Accident after accident has occurred; suits at law to recover damages have crowded the court calendars, and settlements in large amounts have been made, until the grade crossing subject has become a theme for violent discussion in the daily papers and among the people of towns and municipalities throughout the land. The day of grade crossings, therefore, is gradually disappearing, and some railroad companies are already in position to declare that there are now no such crossings on their lines, the New Haven and the New York, Westchester and Boston claiming that distinction. These are wonderful accomplishments, resulting in an absolute protection of the public, as well as the railroads, at points which were formerly the scenes of many disasters, costing many lives and many thousands of dollars in damages. The outlays involved in this modern safeguard have also cost many millions, in which the railroads and municipalities have joined in many instances, according to law, but all these vast expenditures have been warranted in view of established safety and the fact that the interest charges on account of this betterment will be inconsiderable in the end as against the former annual outgo in damage payments and for other claims.

Ornamental Deck Girder Elevated Crossing on Cencrete Piers, L. I. R. R.

In the neighborhood of New York City the Long Island Railroad Company has been among the foremost, of late years, to recognize the importance of such improvements and has already constructed many over or under-grade crossings, and is still engaged in this direction, at tremendous expense because the Long Island country, as a rule, is flat and offers no easy solution of this great problem.

On the Long Island Railroad today there are 953 intersecting highways, 305 of which are absolutely protected either by an elevated or depressed crossing (118 elevated and 187 depressed); 193 are protected by gates, 46 by flagmen or guards, and 72 by other methods, such as bells or other mechanical devices. On a system whose line of railroad is but 400 miles, with unusually frequent train service, the number of highway intersections is much larger and the menace greater than the average. Of this number, then, 616 are protected and 337, which might be called unimportant, at present, are not protected.

The average cost of protecting crossings, in the several ways mentioned, on Long Island is shown as follows:

By elevation	$200,000.00
By depression	200,000.00
Cost of installing gates	350.00
Cost of maintaining gates, per annum	38.60
Cost of installing bells, DC	912.50
Cost of installing bells, AC	1,824.50
Cost of maintaining bells, per annum	78.05
Cost for crossing men at crossings not equipped with gates, per annum	548.44
Cost for crossing men at crossings equipped with gates, per annum	557.12

355 men are employed at crossings equipped with gates and 58 men are employed at crossings not equipped with gates.

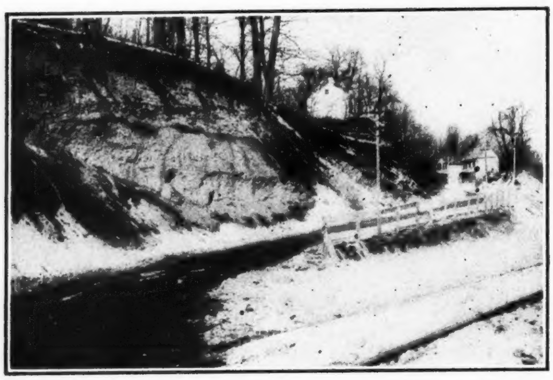
During the past five years approximately 12 grade crossings have been eliminated each year.

Payments made for personal injury claims for accidents occurring at these grade crossings are charged to "Injuries to Persons—Transportation." For the past five years these charges have been as follows:

1910	$171,136
1911	192,330
1912	173,513
1913	222,783
1914	162,317

However, payments on account of claims for other accidents are charged to this same account, and it may not, just now, be possible to establish any exact proportion between the increase of protected crossings and the decrease of damage claims.

The present division in the expense of protecting grade crossings in New York State appears to be as fair as the railroads could expect.



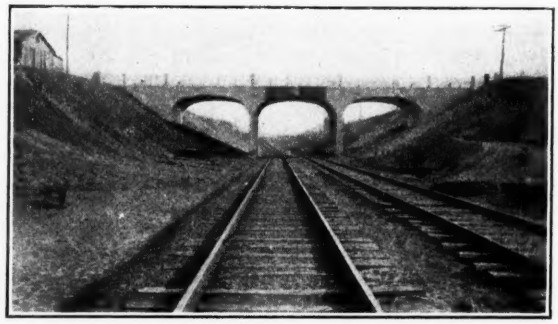
Mill Neck Road Crossing, L. I. R. R.

The Long Island railroad in view of all the circumstances and conditions under which these great improvements have been and are being made is entitled to great credit and consideration.

One of the large railway systems in the West which links Chicago, St. Louis and Kansas City, has devoted much consideration to this important subject of highway crossings. When this line was built between Chicago and St. Louis, 50 years ago, there were barely 100 grade crossings on the line. To-day there are 963, besides a large number where the grades have been separated at great expense. When this railroad was originally constructed the Chicago city limits were at Twelfth street, Since then they have been extended more than 7 miles beyond and there have been opened 110 city streets, at grade, where the railroad intersected. For more than three-quarters of this distance the tracks have been elevated so that the street crossings are now undergrade and the entire expense of this improvement has been borne by the railroad company in spite of the fact that all this territory had been taken into the city limits long after the railroad was constructed and put in operation. The question of fairness in this matter is left to the judgment of every unprejudiced person who considers it.

At present this company has 990 unprotected crossings throughout its system and 315 protected—39 overhead and 87 depressed, 43 by gates, 58 by flagmen or guards, and 88 by bells.

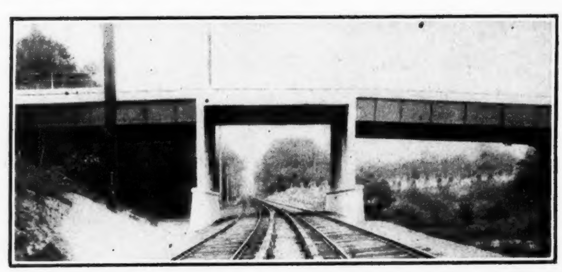
The average cost for elevated crossings, based upon the expenditures for track elevation in the city of Chicago has been $44,303.46. Gate protection at present averages $32.50 per month for wages and $600 each covering the initial expense for installation. Protection by flagmen, alone, averages $30 per month, and the average cost for the installation of electric bells is $300.



Reinforced Concrete Highway Bridge Over Tracks, L. I. R. R.

In the past five years 5 grade crossings have been eliminated. The extreme hard times have prevented expenditures in this direction beyond this. All the railroads in the country have struggled with poverty and its consequences for a long time and the hope arises now that the future has in store better things. Affairs, absolutely necessary, have required rigid attention in spite of needs both public and private, as we all know.

When it comes to the question of an honest division of expense when grade crossings are to be eliminated we come in contact with something regarding which there are many opinions. In the early days, referring to this company's experience, in Chicago, the public and the city authorities, naturally, were of one mind and the railroads shouldered such expenses entirely because they were obliged to do it. Any opposition on their part was hopeless, while the public in a large measure enjoyed the benefit. Sentiment has changed somewhat of late years and the adjustment of expenses for these public improvements has been established in some States upon a percentage basis by law, depending upon circumstances now and then.



Deck Girder Highway Crossing Over Electrified Track, L. I. R. R.

In Pennsylvania, for instance, the court judge, after reviewing the history of the construction of the railroad and the opening of the highway and all the attendant circumstances, determines the percentage of cost which each of the parties in interest shall bear.

Until very recent years, when any grade seperation was ordered by the city or State authorities in Ohio, the cost was divided equally between the railroad company and the municipality. Now the railroad company

in that State is obliged to stand 65 per cent of the expenditure and the public assumes 35 per cent. This is an arbitrary arrangement. In a case involving the separation of grades along a prominent highway in one of the counties of Missouri, the court decided that it would be inequitable to assess the entire expense upon the railroad company and eventually the matter was adjusted by charging the county with 40 per cent and the railroad company with 60 per cent.

Heretofore, in Illinois, the railroads have been obliged to assume the entire expense in such cases. Quite recently, however, in a case wherein two railroads intersected in a growing city and the highway on which was a street railroad intervened, as a factor, the Public Utilities Commission apportioned the expense on a basis of one-third to the steam railroads, 25 per cent of the balance to the street car company, 10 per cent to the municipality and the balance to the State. Under the law in Illinois today no highway crossing can be laid out to cross a railroad until the matter has been approved by the Public Utilities Commission. The question naturally arises, admitting that the common carriers as well as the public, benefit by the growth of the communities through which they operate, what percentage of the

Coney Island Avenue Highway Crossing Over Tracks, L. I. R. R.

cost of grade separation should honestly be borne by them. This is a burning question today. The public demands protection, the railroads are quite in sympathy with the movement, but as both are permanently benefited by such improvements, it would seem only fair that the railroad company should not be called upon to pay more than half the expense in any case. In many circumstances they should be assessed at very much less than this. Absolute protection throughout the country is still a long way off, but the day will be celebrated eventually when the grade crossing menace becomes ancient history.

Handling a Peculiar Drainage Situation

By ALBERT MARPLE

Unusual Culvert Construction to Carry Torrential Flow of Water Safely Under Tracks

A somewhat unusual drainage situation exists on a road in the West, and the manner in which this problem was handled by the engineers of the company is of interest. For possibly half a mile on either side of the bridge we show in our illustration as well as for about a mile away from the tracks the roadways have a gradual descent to this particular point, where they cross the tracks and continue on. On account of this unusual grade situation the water from a large territory east of the tracks, which collects at this point, where, if nothing had been done, it would have simply run over the tracks, probably taking tracks, foundation, etc., along with it. But when this line was constructed a culvert, which the engineers felt sure would take care of this drain water problem for all time, was provided and thus far it has "stood up" under the most severe of storms.

As may be seen in the illustrations this culvert is

End view of culvert

made of concrete. It is 60 ft. in length and 30 ft. wide. As it was necessary for this culvert to accommodate a considerable volume of water the drain openings were made quite large. There are two of them, and each is 8 ft. in width and 2 ft. in height. They are separated by a concrete support which is 10 ins. in thickness and which runs the entire width of the culvert. The concrete floors of these openings have been made 6 ins. thick and at the upper side an "apron" has been run for about three yards back into the earth so as to eliminate any danger of the floor undermining the culvert.

At either side of the culvert and outside the tracks a sort of "walk" effect 4 ft. in width has been laid, while on the surface the section occupied by the tracks is of gravel and sand. Beneath this sandy surface, however, the concrete of the culvert serves as a foundation for the tracks. At the outside of these "walk" sections is a railing made of 2-in. iron pipe, the posts of which are buried in a raised section of concrete which is 6 ins. wide and 4 ins. high.

Side view of culvert

In the construction of this bridge the lower section or base was poured first. This consisted of the floor of the water-openings and the support, as well as the solid concrete sections on either side of the drain openings. After this had hardened sufficiently, the T-rails, which serve as a support for the roofs of the drain opening were placed in position. The forms were placed, then, for the upper half of the culvert, and the concrete of that section was poured. The concrete which serves as a foundation for the surface rails comes 2 or 3 ins. above the rails which constitute the support of the roofs of the water openings. These T-rails have been placed side by side, so as to form a continuous roof across the entire culvert. The standard mixture of 1-2-4, one part cement, two parts sand, four parts broken rock, was used in the construction of this culvert. This concrete work has been given a smooth plaster finish.

New Methods and Appliances

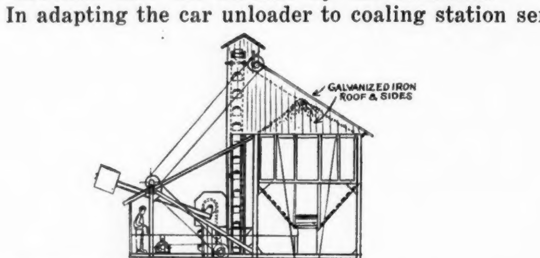
The T. W. Snow Construction Co., 537 South Dearborn St., Chicago, have recently adapted their Seaverns Patent Car Unloader to meet the requirements of small railroad coaling plants. The car unloader is of the bucket chain type, with the chain operating from a counterbalanced beam above, so that the operating height is easily varied from the top of the load to the

Bucket Chain Unloading Car of Sand

bottom of the empty car. This beam is provided with lateral motion sufficient to carry the bucket chain from one side of the car to the other, and the whole car unloader can be mounted to travel on a track, the length of the car.

The great flexibility of the unloader enables it to operate cleanly and quickly—90 per cent. of the material is removed by the bucket chain, and the remainder is shoveled into the buckets by the attendant.

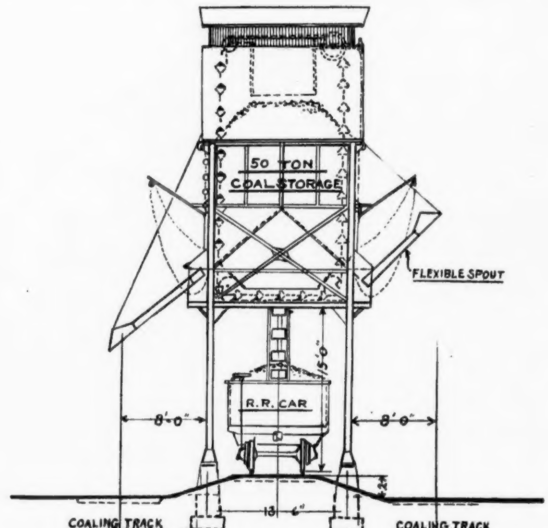
In adapting the car unloader to coaling station serv-



Side Elevation of Coaling Plant

ice, a 50-ton coal storage bin is provided at suitable height, and the unloader carries the coal to a hopper from which a second bucket chain conveyor lifts it to the storage bin. The buckets will handle coal from 6-in. lump down to screenings, and with a 7-hopsepower electric motor, or gas or oil engine, as is most convenient, and one man as operator, the plant can unload a 50-ton car per hour. A niggerhead and switch rope can be used to haul the loaded cars up to the machine, and the empties away. The relative positions of car, unloader, conveyor and storage bin are shown in the second illustration.

If the unloading track is laid between two coaling tracks, and flexible spouts are provided, the station can deliver coal on both tracks, as indicated in the third illustration. The plant will operate at a very low cost per ton, and it is claimed that the results are as economical as are obtained in the largest plants.



End Elevation of Coaling Plant

The initial cost of the plant is much reduced by the fact that no excavation or pit is required, as would be necessary with a balanced bucket coaling station. In speed and economy of operation this plant quite equals the results of plants of other types which for outlying stations would be prohibitively expensive.

Mudge & Company, Railway Exchange building, Chicago, have recently introduced to the railway engineering department the Smith Motor Wheel, for application to track speeders. This wheel is now in use attached to bicycles throughout the United States, and its adaptation to track cars places this form of power at the disposal of track men.

Investigation has shown that direct application of engines to the thousands of hand speeders now in service has been found impracticable. The light frame construction of a speeder will not adequately support its own motor and a troublesome and unnecessary expensive "makeshift" has been the reward for many operators who have tried to rebuild their speeders into motor cars.

With the Smith Motor Wheel the man with the "Old Armstrong" can now fit himself out with a motor driven car which will release him from laborious pumping and his slow method of getting over the ground.

The motor wheel which is the entire power plant within itself, is hitched behind the velocipede and employed as a pusher. Special appliances for attaching are, of course, necessary and these are built and furnished free in accordance with certain dimensions given by the speeder owner. The engine is the four-cycle, air cooled type, 2⅜-in. bore by 2½-in. stroke, and develops 1½ horsepower. It is magneto equipped and is throttle governed by means of a flexible tubing control fastened to handle bars or conveniently on seat board. Any

speed from four to twenty-five miles an hour can be set and maintained.

Some idea of the capacity of this motor wheel can be gained from the fact that for a test two of them applied to the rear of a seven-passenger Franklin automobile easily propelled it on a several mile run. The wheel complete weighs but fifty pounds and with its heavy rubber tire gives ample tractive power to carry one, and under favorable conditions, two men on a speeder. It is quickly attached and detached and can be taken off

The Smith Motor Wheel attached to track speeder

at night and locked up if it is desired to leave the speeder out of doors. When not in operation it is hooked up to the frame of the speeder about an inch over the rail so that the handle bars can be used if desired.

The Carborundum Company, Niagara Falls, N. Y., are introducing a new hand power grinder, especially adapted to the requirements of railroad section gangs and construction gangs. This grinder was designed after consultation with a number of prominent railroad engineers and has a number of features which merit attention. The size and strength of the malleable

The Carborundum Company's new hand-power grinder for section work

iron clamps make it possible to attach this machine to a hand car or the sill of a car or any other convenient place where the thickness of platform does not exceed 5 ins. The size and length of the handle gives ample power; the length of the bearings and the size of the spindle insure minimum maintenance; the hand tool rest can be adjusted to any angle or position on the wheel that can be required, and the quick and easy method of fastening the attachments by means of wing nuts and keyed bolt ends saves time in making adjustments.

Attachments can be furnished suitable for grinding all of the principal tools used by construction gangs and maintenance of way gangs, including twist and flat drill attachments; chisel attachment; scythe attachment, and trueing attachment.

Attachment for properly grinding twist drills

The flat drill grinding attachment makes it possible to grind a flat drill to an oval edge similar to the edge obtained on a twist drill, is understood to be the most desirable edge. At the same time if a flat edge is preferred it can be ground.

The twist drill and flat drill attachments are equipped

Attachment for grinding oval edge on flat drill

with a ratchet feed dial having a major and minor adjustment, allowing of a feed of .006 in. on the drill being ground, and either attachment will grind drills from 1/4 in. to 1 1/2 in., and will also grind small drills with large shanks and large drills with small shanks, or

Attachment for grinding scythe

drills with tapered shanks. These two attachments allow of lateral motions across the face of the wheel and also up and down to give the oval edge. All attachments are simple in design and made of malleable iron to provide the necessary strength to bear the work for which they are intended.

New Trade Literature

American Blower Company, Detroit, Mich., have issued a 44-page illustrated book on "The Commercial Value of Washed Air," in which are described, by noted authorities, the advantages to employer and employee of using washed and tempered air. The remainder of the book is given to a description of the construction and operation of the "Sirocco" purifying and ventilating system and the sizes and capacities of various types of various installations.

The American Lighting Co., 617 Jackson blvd., Chisago, have recently issued a 6-page illustrated circular describing the Sunlight Flood incandescent lamp for outdoor and indoor flood lighting, operating on D. C. or A. C. current, burning 1,000 watts, lighting 8,00 0sq. ft.

The American Steel & Wire Co., 30 Church St., New York City, have issued a 64-page book on railroad fences, gates and steel fence posts, in which the service of a railroad fence is analyzed and the qualities of their products which meet this service are described. Free building instructions for setting up fence under all railroad conditions are a feature of the book.

The Dake Engine Company, Grand Haven, Mich., have issued their 48-page illustrated catalogue for 1915-1916, covering their line of air and steam motors for jib cranes and hoists, swinging gears, hoisting engines, derrick crabs, pneumatic chain and wire hoists, drilling hoists, boiler test pumps, steam feeds for saw-mill carriages, etc. In addition to illustrating this line of material the catalogue gives piece-part names and numbers for replacements and current price-list.

The Fairmount Gas Engine and Railway Motor Car Co., Fairmount, Minn., have issued a 20-page illustrated catalogue, describing the manufacture and uses of their line of motor cars from engine outfits to be installed on existing speeders to extra gang cars which will haul loaded trailers carrying an extra gang of a hundred men —or six or eight tons of construction material.

The Frost-Superior Fence Company, Cleveland, Ohio, have issued a 48-page illustrated catalogue on galvanized woven wire railroad fence, woven wire gates, coiled spring wire and fence builders' supplies and tools. Instructions for stretching fence and hanging gates are included as well as data in regard to weight and strength of various sizes of fence.

Gerdes & Company, 30 Church St., New York City, has issued an illustrated mailing card describing the Gerdes hygienic method of direct forced draft ventilation, applicable to machine shops with or without balconies and to general building construction.

The Hatfield Rail Joint Manufacturing Company, Macon, Ga., have issued a 6-page illustrated circular describing the Hatfield Rail Joint. The circular contains an analysis of the forces to be met by a rail fastening and shows how the Hatfield Rail Joint fulfills these requirements.

The Industrial Works, Bay City, Mich., have issued a 90-page illustrated book No. 107, on their complete line of cranes, illustrating and describing portable and stationery cranes on many different types and capacities designed for railroad and construction purposes, pile drivers, portable rail saws, transfer tables and various accessories. Cranes are shown operated by steam, electric and hand power. The completeness of the apparatus illustrated and the frankness with which the capacities and uses of the various types and sizes are stated, is a valuable part of the book.

The Ingersoll-Rand Co., 11 Broadway, New York, have issued an 80-page illustrated catalogue on equipment for lifting water by compressed air, describing the theoretical and practical principles involved, and giving tables of sizes of equipment necessary to produce various rates of flow, and various lifts in feet.

The Kernchen Company, McCormick Bldg., Chicago, Ill., have issued a 16-page illustrated bulletin on the Kernchen Siphonage Ventilator, including descriptions of installations, records and data with regard to tests and some matter on the theory of ventilation. A list of sizes and capacities of ventilators is included.

The Link Belt Company, Chicago, Ill., have just issued a 576-page, illustrated, general catalogue, containing views and descriptions of the links and attachments for their various types of link-belt and chains, as well as bearings, brackets and hangers, take-ups, buckets, screw conveyors, weight boxes, car unloaders and coaling station elevators, and special equipment.

The Monroe Calculating Machine Co., Woolworth building, New York, have issued an illustrated circular describing the uses of the Monroe Calculating Machine in engineering and contracting offices. The machine will add, subtract, multiply, divide or combine these processes in any way desired.

The National Roofing Company, Tonawanda, N. Y., have issued a 16-page illustrated book on the use of "Hydrolox"—a water-proofing for Portland cement. A discussion of the principles of water-proofing is presented, and then more specifically, the integral and the plaster-coat systems of water-proofing are discussed. The results of tests are included.

H. A. Rogers Company, 87 Walker St., New York City, have issued a 20-page illustrated catalogue on the Heintz steam trap for steam heating systems. The book contains a discussion of condensation and the means for dealing with condensation as well as instruction for setting up the apparatus.

The Star Headlight and Lantern Co., Rochester, N. Y., have recently issued a 136-page illustrated catalogue describing in detail their complete line of electric, acetylene gas and oil headlights, and signal, switch, water gauge and cab lamps for steam railway service.

The Western Wheeled Scraper Co., Aurora, Ill., have issued a 16-page illustrated bulletin on the Western Automatic Air Dump Car, describing the standard Western dump cars with a new air dumping device, which tilts the bed of the car and raises the side with one movement. The construction and operation of the car are illustrated as well as different types of service to which it can be put.

Westinghouse, Church, Kerr & Company, 37 Wall St., New York, have issued a 12-page illustrated bulletin, No. 20, on the lay-out and equipment of the locomotive repair shops of the Chicago & Alton Railroad, at Bloomington, Ill. The bulletin discusses the theory of building a shop around a predetermined machine lay-out, rather than attempting to advantageously lay out machines after the shop building has been completed.

Westinghouse Electric Manufacturing Company, East Pittsburgh, Pa., have issued a 16-page illustrated reprint of a paper presented at a meeting of the Railway Club of Pittsburgh, by E. M. Herr, president of that company. The paper deals with electric power development through successive sizes of generating units with relation to industrial and railway electrification projects.

Personal Items for Railroad Men

W. H. Holt, recently appointed supervisor of the Norfolk Southern Ry. at Star, N. C., succeeds F. L. Lilley.

R. R. Sheetes, recently appointed signal inspector of the Chicago & Northwestern, succeeds W. H. Hometh.

C. J. Dixon, recently appointed roadmaster of the Seaboard Air Line at Athens, Ga., succeeds J. Landrum.

M. C. Manney has been recently appointed signal inspector of the Chicago and Northwestern Ry. at Chicago, Ill.

I. S. Lhoyd, recently appointed chief engineer of the Tellsmere R. R. at Tellsmere, Fla., succeeds W. A. James.

J. Landrum, recently appointed division engineer of the Seaboard Air Line at Atlanta, Ga., succeeds J. L. Kirby.

J. L. Kirby, recently appointed division engineer of the Seaboard Air Line at Hamlet, N. C., succeeds A. O. Wilson.

R. G. Henley, recently appointed foreman of the Norfolk & Western at East Radford, Va., succeeds there W. Buddwell.

L. D. Fisher, recently appointed roadmaster of the Detroit, Toledo & Ironton R. R. at Adrian, Mich., succeeds O. Climer.

L. Vogland, recently appointed assistant roadmaster of the Great Northern Ry. at St. Cloud, Minn., succeeds L. Kiloran.

A. Eckstrom, recently appointed assistant roadmaster of the Great Northern Ry. at Great Falls, Mont., succeeds A. Kemp.

James A. West, recently appointed roadmaster of the Chicago, Rock Island & Gulf Ry. at Dalhart, Tex., succeeds C. B. Lane.

L. J. Gilmore, recently appointed assistant roadmaster of the Great Northern Ry. at Kelley Lake, Minn., succeeds Fred Graba.

J. J. McCarthy, recently appointed assistant roadmasmaster of the Eastern Texas R. R. at Lufkin, Tex., succeeds H. L. Pirkle.

A. G. Savage, recently appointed roadmaster of the Texas & New Orleans R. R., at Jacksonville, Tex., succeeds A. H. Maher.

H. Wilburne, recently appointed roadmaster of the Galveston, Harrisburg & San Antonio at Victoria, Tex., succeeds H. J. Gordon.

W. H. Maxwell, recently appointed roadmaster of the Montreal & Southern Counties Ry. at St. Lambert, Que., succeeds H. B. Fleshman.

B. G. Womack, recently appointed roadmaster of the Galveston, Harrisburg & San Antonio at San Antonio, Tex., succeeds P. Sweeney.

Edw. M. Boggs, recently appointed chief engineer of the San Francisco-Oakland Terminal Rys. at Oakland, Cal., succeeds C. H. Rinkley.

J. M. Romney, recently appointed supervisor of bridges and buildings on the Guantanamo Ry., at Guantanamo, Cuba, succeeds P. Desjaigne.

I. T. Phillips, recently appointed general foreman of bridges and buildings of the Norfolk Southern Ry. at Norfolk, Va., has been serving as supervisor at Wilson, N. C.

S. L. McClanerhan, recently appointed division engineer of the Chicago, Rock Island & Pacific at Good Land, Kan., has been serving as assistant engineer at Colorado Springs.

W. D. Brown, recently appointed general manager of the Mineral Point & Northern Ry. at Mineral Point, Wis., has been serving that road in the capacity of assistant general manager.

N. F. Shipley, recently appointed foreman of Section 52, Glassport yard of the Pittsburgh & Lake Erie Railroad, was in 1915 promoted from track walker to assistant foreman of work train, and later to extra gang foreman, before his recent promotion.

J. W. McCraw, recently appointed roadmaster of the Third District of the Western Division of the El Paso & Southwestern System, at Tucson, Ariz., succeeding O. G. Horton, transferred, has spent the last three years as section foreman in the Tucson yards.

R. L. Mason, who has been connected with Hubbard & Company, manufacturers of railway track tools, for the past 14 years in the capacity of manager of the railroad department, has left that firm to form a railroad supply company of his own at 1501 Oliver building, Pittsburgh, Pa.

J. H. Minton, recently appointed assistant engineer in the maintenance of way department of the Nortswest System of the Pennsylvania Lines West, succeeding D. M. Craig, resigned, has been continuously in the service of the construction and maintenance of way departments of that road since 1907.

F. A. Benz, recently appointed division engineer on the Buffalo, Rochester & Pittsburgh Railway at Rochester, N. Y., with jurisdiction over Divisions 1 and 2, and the Erie Division, entered the service of that road in 1906, and was promoted from the position of assistant engineer, to succeed John P. Reynolds, deceased.

E. R. Lewis, assistant to the general manager of the Duluth, South Shore and Atlantic Ry. at Duluth, Minn., has had his jurisdiction extended to include all matters pertaining to engineering, maintenance-of-way and structures, and also valuation work of the Duluth, South Shore & Atlantic Ry. and the Mineral Range R. R.

R. C. Emmett, recently appointed roadmaster of the New Mexico Division of the Atchison, Topeka & Sante Fe R. R. at East Las Vegas, N. M., succeeding L. Lenehan, deceased, entered the employ of that road in 1898, and has served continuously since, as extra gang and section foreman on the Chicago Division.

C. L. Bartholome, recently appointed signal supervisor of the Vandalia Railroad at Terre Haute, Ind., succeeding C. W. Hixson, transferred, has been in the service of the Pennsylvania Lines West since 1905, as signal repair man, draftsman, wireman, signal inspector, signal foreman, signal supervisor, before being transferred to Terre Haute.

F. J. Blauvelt, recently appointed division engineer of the Lehigh Valley Railroad at Auburn, N. Y., entered the service of that road in 1903 as stenographer and a few months later entered the engineering department as rodman, and serving in various capacities until early in 1915, he was promoted from assistant engineer to supervisor of track at Cortland, where he remained until his present appointment.

John T. Bealor has recently been appointed by the Homestead Valve Manufacturing Co., Pittsburgh to have charge of their new department in which they have the eastern territory for the Taylor Steam Specialty Company of Battle Creek, Mich. Mr. Bealor is in a position to render expert advice and service on matters pertaining to vacuum exhaust steam heating systems, and to returning condensation from exhaust steam to boilers.

F. D. Cosner, recently appointed engineer maintenance of way, succeeding R. H. Pembroke, resigned, on the Coal and Coke Ry., at Elkins, W. Va., served from 1903 to 1905 in the U. S. Corps of Engineers in the Philippine Islands. In 1905 he started work in the location and construction of the Coal and Coke Ry. In 1906 he was location engineer for the R. & P. S. Ry. and the T. & N. C. Ry. In 1907 he was appointed resident engineer on the Albemarle Sound bridge on the N. & S. Ry. This bridge is five miles long over a single bed of water. In 1908 Mr. Cosner was appointed location engineer of the R. & N. Ry., and in 1910 had charge of the building of a bridge for the C. & C. In 1910 he did construction work in Arizona for the E. P. & S. W. System, and in 1912 went to South America to work on the Pan American Ry. at Durozua, Uruguay. In 1913 he was appointed assistant engineer in the Bureau of Engineering Statistics of the J. G. White Co., which position he held until the announcement of his present appointment on the Coal and Coke Ry.

L. W. Turner, recently appointed roadmaster of the Second Division of the Georgia & Florida Railway at Vidalia, Ga., started railroad work in 1899 as section laborer on the A. K. & N. Ry., at the age of 14 years, and in 1899 was appointed night yard foreman of the D. S. C. & I. In 1901 he was made foreman of the Mineral Bluff section of the A. K. & N. and in 1902 took charge of the construction of the yards of the Tennessee Copper Co. at Copperfield, Tenn. Following this work, he was engaged in contracting and railroad operating work until in 1906 he had charge of building the Snow Bird R. R. from Andrews, N. C., to the Little Snow Bird River. After this work was completed Mr. Turner held a number of positions in the engineering and transportation departments of railroads in that section, and in 1911 was appointed supervisor of the North Division of the G. & F. In 1912 he was made roadmaster, and in 1913 assistant general roadmaster, where he remained until the road was divided into two roadmasters' divisions, when he received his present appointment. Mr. Turner has been identified in his eighteen years' railroad work with some very interesting construction work, including having charge of the construction of the Smoky Mountain loop at Farmer, Tenn., and of the largest sulphuric acid plant in the south, at Copperhill, Tenn.

Trygve D. Yensen, for his success in development of alloys of iron possessing remarkable electrical properties, has been promoted, effective January 1, to be Research Assistant Professor of Electrical Engineering of the University of Illinois. Mr. Yensen has not only duplicated what other investigators have done, but he has produced metal, the magnetic permeability of which is many times greater than any that has before been produced. It is understood also that he has not only done this once, but his procedures have been so systematic that he can duplicate with certainty any result which has thus far been obtained. His work has attracted wide attention, and visitors to his laboratory have come from every part of this and other countries. Mr. Yensen's results have been obtained through the melting of metals in vacuo by the use of an electric furnace. He is the author of a considerable number of scientific papers and of the following bulletins of the Illinois Engineering Experiment Station: No. 55. "Starting Currents of Transformers with Special Reference to Transformers with Silicon Steel Cores." No. 72, "Magnetic and Other Properties of Electrolytic Iron Melted in Vacuo." No. 77, "The Effect of Boron upon the Magnetic and Other Properties of Electrolytic Iron Melted in Vacuo." No. 83, (in press) "The Magnetic and Other Properties of Iron-Silicon Alloys Melted in Vacuo."

Obituary

John I. Johnson, general superintendent of the Central of Georgia Railway, died at Savannah, Ga., Sept. 21, last. He was not only popular, but able. He was in every sense a self-made man, commencing as a trainman and advancing steadily until he became general superintendent. Mr. Johnson was 53 years old and was born in Hanover county, Virginia. In his death the Central of Georgia loses an executive of the highest class. It is a source of extreme regret that he should pass away in the midst of his usefulness and activity.

Association of American Portland oement Manufacturers

At the annual meeting of the Association of American Portland Cement Manufacturers, held in New York on December 15, 1915, the following officers were elected:

President—B. F. Affleck, president Universal Portland Cement Co.

First Vice-President—F. W. Kelley, president Helderberg Cement Co.

Second Vice-President—Richard Hardy, president Dixie Portland Cement Co.

Treasurer—G. B. Brown, president Alpha Portland Cement Co.

Assistant Treasurer—John J. Matthew, treasurer Alpha Portland Cement Co.

Assistant Secretary—L. R. Ferguson.

Percy H. Wilson, who has served as secretary for a number of years, resigned and J. P. Beck was elected general manager of the association. The association unanimously approved of a comprehensive plan for enlarging the activities of the organization submitted by Mr. Beck, and by resolution the executive committee was instructed to carry into operation the proposals in the report.

The Savannah & Northwestern, C. E. Gay, Jr., general manager, Savannah, Ga., are in the market for several miles of relaying rail.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF AUGUST 24, 1912, of RAILWAY ENGINEERING AND MAINTENANCE OF WAY, published monthly at New York, N. Y., for October 1, 1915.

Editor—Benjamin Norton, 2 Spring Street, New Rochelle, N. Y.

Managing Editor—George S. Hodgins, 390 Wadsworth Ave., New York City.

Business Manager—Joseph A. Kucera, 52 Vanderbilt Ave., New York City.

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Owners (if a corporation, give its name and the names and addresses of stockholders holding 1 per cent. or more of total amount of stock; if not a corporation, give names and addresses of individual owners)—Railway Periodicals, Inc., 52 Vanderbilt Ave., New York City. Ernest C. Brown, 52 Vanderbilt Ave., New York City. Charles S. Myers, 324 East 26th Street, Brooklyn, N. Y.

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RAILWAY PERIODICALS COMPANY, INC.
S. A. BATES, Treasurer.

Sworn to and subscribed before me this 22nd day of October, 1915.

ANDREW O. REINS,
Notary Public, Kings Co., No. 62.
Certificate filed in New York Co., No. 52
Kings Co. Register's Office, No. 6050
(My commission expires March 31, 1916)
New York Co., Register's Office, No. 6118

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See Hand Cars and Inspection Cars.

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Cranes.
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Nichols, Geo. P., & Bros.

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Dixon, Jos., Crucible Co.

Crossings.
See Frogs and Crossings.

Derails.
Indianapolis Switch & Frog Co.

Dump Cars.
Kalamazoo Switch & Frog Co.

Electric Batteries.
See Batteries, Electric.

Engines, Gasoline.
See Gasoline Engines.

Fence Aprons, Wing.
Calumet Supply Mfg. Co.

Fence Posts, Steel.
Calumet Supply Mfg. Co.

Flash Lights.
Com. Acetylene Ry. Light & Sig. Co.

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Kalamazoo Railway Supply Co.

Gasoline Engines.
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Gasoline Motor Cars.
See Motor Cars, Gasoline.

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Hand Cars.
Kalamazoo Railway Supply Co.

Hoes.
Hubbard & Co.

Inspection Cars.
Kalamazoo Railway Supply Co.

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Kalamazoo Railway Supply Co.

Manganese Frogs and Crossings.
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Frog, Switch & Mfg. Co.
Indianapolis Switch & Frog Co.
Ramapo Iron Works.
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Motor Cars.
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See Tie Plates.

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Classified Index of Advertisers—Continued

Alphabethical Index of Advertisers

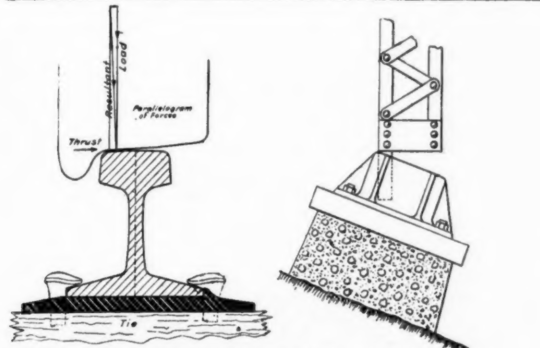
RAILROAD TIE PLATE PRACTICE
— A COMPARISON —

The Resultant Force, due to a wheel load on a rail and the wedging action of the coning of the wheel, is at right angles to the direction of this coning.

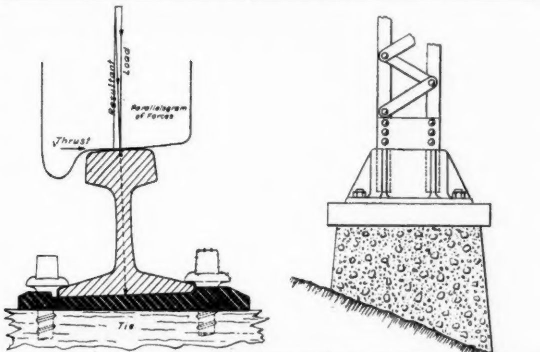
This Resultant is the force bearing from the wheel on the rail, independently of the necessary "nosing" action of the wheel flange on curves.

In the diagrams shown below, the bearing of the wheel on the Rail, Tie Plate and Tie is compared with the load acting between a Steel Column resting, through a Shoe and a Masonry Foundation, on Sloping Rock. The column load is vertical, while the bearing of the wheel on the rail is at an inclination of one in twenty. The track sketches are to scale, while the foundation sketches are exaggerated to emphasize the point made.

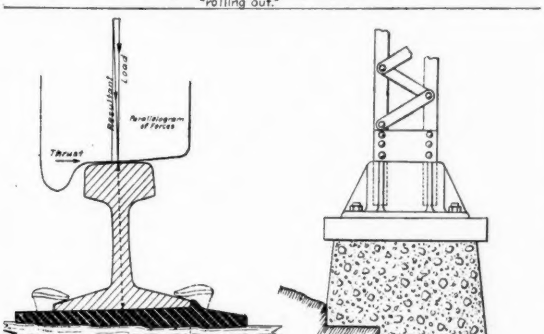
The Wheel corresponds to the Column
" Rail " " " Shoe.
" Tie Plate " " " Masonry
" Tie " " " Sloping Rock



THIS ILLUSTRATES FLAT TIE PLATE PRACTICE.
Rail and Plate tend to "roll out."



THIS ILLUSTRATES EUROPEAN WEDGE PLATE PRACTICE
Note the heavy bolts required to keep the plate from "rolling out."



THIS ILLUSTRATES SCIENTIFIC MODERN TIE PLATE PRACTICE.
The Seating of the plate is normal to the resultant force bearing on it. The Plate will not "roll out" from the resultant force shown, but will hold the track to gauge

In addition to being seated at right angles to the resultant of the forces acting on it, the Lundie Tie Plate is cambered lengthwise to the rail, so permitting the rail to travel over the surface of the plate with a gentle flexing motion as wheel loads approach to and recede from it, giving smooth riding track. With a flat plate, the rail, under approaching and receding wheel loads, tilts the plate by coming in contact with its edges, so inducing rocking ties and rough riding, clattering track

New Wheels and Rail over The Lundie Tie Plate will tend to retain their standard contours. Worn Wheels and Rail over The Lundie Tie Plate will tend to return to their standard contours

THE LUNDIE TIE PLATE
IS HANDLED COMMERCIALLY, DIRECTLY BY

JOHN LUNDIE, 52 Broadway, New York City

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All that is needed back of

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is a husky laborer, ready to do a full day's work.

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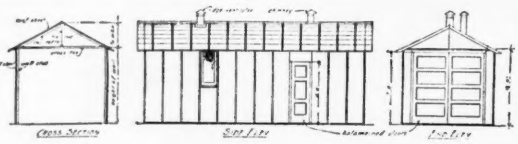

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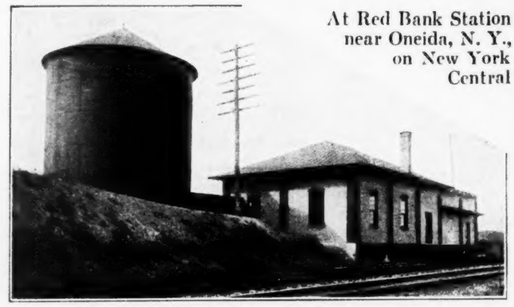

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Write for our new catalogue to the

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Points of Merit of the Indianapolis R-N-R Frogs

No. 1. Requires no renewals or removing during life of Manganese.

No. 2. Minimum length of solid Manganese Frogs.

No. 3. Full length track rails fit into recesses of Frog, making all joints self-contained.

No. 4. Cost, maintenance and use of three pairs of splices eliminated.

No. 5. Perfectly foot guarded at heel, toe and flares, meeting all requirements of all railroad commissions.

No. 6. Clamping toe plate gives uniform bearing to base of rail, re-enforces the easer extensions and absorbs all outward thrust strains.

No. 7. Adjustable wedge block at toe keeps rails tight, preventing flange interference.

No. 8. Easement at heel and toe protecting rail ends, eliminating joint impact.

No. 9. Wing rail easers continuous, protecting point and eliminating wear from worn teirs at throat.

No. 10. Design admits of a standard and fixed dimension for a given NUMBER and rail section, uniform for all roads.

Points of Merit of Solid Manganese Frogs in General

The following points of ECONOMY, ADVANTAGE and MERIT compared with ordinary bolted or manganese insert bolted frogs apply to the various types and forms IN GENERAL of solid manganese cast construction.

No. 1. Integral, no separate members to work loose, requiring constant maintenance.

No. 2. One-piece construction reduces chance of derailment through broken or misplaced parts as in fabricated work.

No. 3. One-piece frogs maintain alignment and throat-ways.

No. 4. Genuine Manganese Steel gives several times the wear of Bessemer or Open Hearth.

No. 5. When worn down at points of severe service, can be refaced by Electric Welding and resurfaced.

No. 6. Will withstand damage of Derailments.

No. 7. Cast from pattern, ends can conform to foreign section without compromise.

No. 8. Self-contained structures conserve tie system.

No. 9. Solid Manganese Frogs properly designed and of genuine material show greater strength and larger safety factor than built up construction.

No. 10 Solid one-piece construction is not affected by the elements and does not deteriorate as rapidly through wear as the component parts of assembled structures.

The Indianapolis Switch & Frog Co., Springfield, Ohio

2 copies Ry. Eng. Jan. 1916